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(Inscribed to the British LAND and SEA OFFICERS.)

T H E
BRITISH MARS

C O N T A I N I N G
Several S C H E M E S and I N V E N T I O N S,
To be Practised by L A N D or S E A
Against the E N E M I E S of G R E A T - B R I T A I N .

Shewing more plainly,
The great Advantage B R I T A I N has over other
Nations, by being M A S T E R S at S E A .

I N T W O P A R T S .

Part I. contains.

The Construction of Boats both to
stow in less room in Ships, and go
swiftly, to discover an Enemy's
Coast, and to land and embark
Troops with greater Safety; also
to construct Vessels to lye nearer
the Shore, to better protect the
Troops in landing or embarking;
also rolling Defences to be used as
floating Batteries, or as Floats for
landing Cannon, &c. and for
making Defences and Batteries on
Shore more expeditiously, and for
filling up Ditches, &c.

Also contains a Method to fit old
Ships of War and small floating

Batteries, to batter land Defences
with greater Force; and another
Method to fit old Ships of War
(that cannot be sunk by Shot) to
lye before Batteries and receive the
Shot, while other Ships pass by;
with Remarks and Observations.

Part II. contains

Methods to fortify dwelling Houses,
that even Women and Children
may defend themselves from In-
dians with small Arms, designed
for our Settlements in America,
and other Places.

Also a new Method of Fortification,
and making Batteries.

T O W H I C H I S A D D E D , A N

A P P E N D I X ,

Containing a Scheme for Manning the B R I T I S H N A V Y ,
with less Grievance to the Subject;

And a Scheme to employ S E A M E N : Of a C O P P E R M I N E
near Hudson's Bay: And of discovering the N O R T H - W E S T
P A S S A G E , or determine there is no such Passage; with
Cautions and Directions.

By J O S E P H R O B S O N , E N G I N E E R .

The whole Illustrated by Eleven P L A T E S .

L O N D O N :

Printed for the Author; and Sold by William Flexney,
near Gray's-Inn Gate, Holborn. MDCCLXIII.

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ERRATA.

Page.	Line.	
106	16	for H. interior, read H. exterior.
107	22	Fig. 2. r. Fig. 1.
104		In the last line of the N. B. for will that, r. that will.
123	34	read four, five, or six Feet deep.
125	33	for bend r. bond.
134	15	or r. on.
149	24	accure r. occur.
168	14	wte r. twelve.
168	15	ntenty r. twenty.
196	9	1 ft. 9 in. r. 1 ft. 7 in.
		In the NOTES.
7	4	cover the from the Enemy's view, r. cover the Enemy from the Boat's Fire.
13	9	Sea r. Shore.
69	2	Battle r. Batter.
85	12	Muzzrling r. Muzzle Ring.
104	29	ende r. render.

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P R E F A C E.

WHILST England is blessed with a naval Force superior to any Nation in the World ; whilst she is blessed with every Material sufficient to improve that Force ; whilst our naval Strength is the chief Defence of this Nation, and the only Means to humble the Pride and distress the Trade of our inveterate Enemies ; and whilst she is blessed with a number of able and experienced Officers and Seamen, that have Courage and Resolution to undertake any Scheme that the Government finds necessary to be executed for the Interest of this Kingdom, it is surely the Duty of every Well-wisher to his Country to employ his leisure Hours in Thoughts that may be useful, especially in the Improvement of our naval Force, or on any other Means that may render Attacks at Sea or on the Enemy's Coast, more probable of succeeding, and with as little Risque and Hazard as possible of the Lives of so many brave and useful Subjects.

It is from this Motive only, that I have ventured to set my Hand to Paper to shew a willingness at least to contribute to the Public Good ;

and
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The chief object of the author is to shew the necessity of a more extensive and complete system of naval education, and to shew that the present system is inadequate to the wants of the service.

and as our Royal Navy seems yet a little deficient, I have more particularly adopted for my Plan the Construction of sundry useful Vessels, as well as the Art of Fortification and Attacks by Sea and Land; which, tho' incorrect as it is, yet I am in great Hopes such Improvement may be made upon it by our able and experienced Artists, as may answer in great Measure the End proposed: And tho' every new Plan or Scheme may, at first View, seem difficult and impracticable to many People that are unacquainted with the Nature of it; yet I am fully persuaded the ingenious Sort will find something in the following Sheets that will be thought worth their Study and Observation.

As our Miscarriages on the French Coast have been greatly owing to the want of a sufficient Number of small Craft and Boats, and that occasioned chiefly for want of Room in the Ships to stow or carry more, I shall first treat of a reconnoitring Boat, and as such on their Duty run great Risque and require the greatest Dispatch, every Art or Contrivance (that is but of any Advantage to make her row or sail the better) ought to be used. And then I shall treat of Boats to land or embark Troops on an Enemy's Coast. As such Boats usually made Use of have hitherto been found so inconvenient to stow on board Ships, that but few have been provided (from hence our Attempts have miscarried, and many a brave Soldier and Seaman have lost their Lives, for want of a sufficient Number to take off
all

mean him rays if you don't understand

P R E F A C E. iii

all the Troops at once.) I have contrived for a better convenience of Stowage, that they be built in such a Manner as to part in Halves, lengthways; so that as many of them may be carried in one Ship upon any Expedition, as will land all her Men at once: And however odd it may appear at first View by being built in Halves, an ingenious Carpenter or Boat-Builder, I am well perswaded will soon render it practicable and easy.

often
The first words I found any of your Countrymen will best with a new List

I next proceed to treat of different Vessels to cover the landing of Troops in shoal Water, and their Method of Defence for the better Security of their Men; and as the greatest Part of it will consist of wooden Rowls in different Sizes, which I make no Doubt will be laughed at, at first View, as well for the Oddity as the Expence, yet be assured, when they are duly considered, they will be found to be of excellent Service almost in every Action, not only by Way of Parapet, but will make exceeding good Floats to land Guns or Horses, or any other great Weight or Lumber: Then after having given you a short Description of a scaling Ladder, and of a Bridge to cross a Ditch; and referred to several practical Observations on landing Men; Defences when landed; and on the Security and Advancement of Troops in the Face of an Enemy. I then proceed to show the Usefulness of old Men of War, and a Method how to prepare and make them do good Service after they have been unfit for further Use in the common Way.

The

it would be more to your credit & the Country if you were than was said to the old Men who have wanted the Service of them here in Men of War

Then after treating of the Means Britain has to take the Enemy's Sea-Ports, and destroy their Shipping, I shall just give a short Sketch of the Method that was designed for the better manning the Navy, which was not my own; but since Mr. *Hume's* and Mr. *Blake's* Plan, have appeared, it will be needless to enlarge further on that Head, so shall conclude with some Observations tending to show the great Advantages Britain has, and may keep if she pleases, over all the Powers of Europe.

It appears to me so very easy (in fine Weather) to lay Bodies in the Sea (which the Enemy from the greatest Batteries cannot sink; indeed a chance Shell may do Mischief to some of such Bodies, but the Uncertainty of Shells hitting a Ship is so great, that Shells in this Case need be little regarded) before Forts and Batteries, that will usually prevent the Cannon on Shore from doing any considerable Damage to the Hulls of Ships which are running past, that I cannot but think it something strange that Britain has not attempted something of this Kind to go into the French Harbours and destroy their Ships.

It seems to me very practicable that old Ships of War, as before mentioned (or other Bodies made on Purpose) may be laid before the Batteries at the Entrance of any Harbour, (or any Place I have seen) that Men of War may run into the Harbour under such Cover, with Safety as to their Hulls.

The

P R E F A C E.

The keeping a powerful Squadron before an Enemy's Port, is both dangerous and expensive, especially in Winter, and often doth not answer the End; for there are many Difficulties and Disappointments attending a Fleet at Sea, whose Business is to keep near an Enemy's Coast: And Experience teaches that Ships may escape out of Port, notwithstanding the greatest Diligence in a Fleet at Sea to keep them in; I must acknowledge I cannot help being somewhat positive that Means may be used (by a Nation that is so greatly superior at Sea as Britain is to France) to go into Brest, or any Port in the World, and destroy the Ships there, at a much less Expence of Blood and Treasure than the keeping Fleets at Sea to block up Ports.

It is evident that Britain (at present) has the Means to protect any thing upon the Sea; and can, in some Measure, block up the Enemy's Fleets in their Harbours; but by many Years Experience it is known, their Ships have often found Opportunities to slip to Sea, notwithstanding a powerful Squadron employed to block them up in the Port; and I think there are few Instances of our Fleet intercepting the Enemy's Fleet, particularly the Brest Squadron.

If there was indeed a good Road where our Ships could lye safely all Weathers, at the Entrance of the Enemy's Harbours, they might keep them blocked up; but, except in fine
Weather

Weather, it is not practicable to reduce the blocking Ships up in a Harbour to any Certainty.

For if a Gale of Wind blow strong upon the Shore, the Fleet at Sea that must not go for the Harbours, will ply to Windward: Nor can they be safe or easy till they have got a good Offing, perhaps several Leagues out of Sight of Land; upon which the Wind may alter so as to bring the blocked up Ships out of Harbour, and they may be at Sea three or four Days before the Ships that blocked them up can beat to Windward, and regain their Station off the Harbour's Mouth:

Or a Storm of Wind may blow the Ships from the Shore so far, that when the Storm is abated, the blocked up Ships may have an Opportunity to put to Sea without much Hazard of being intercepted, except met at Sea by Chance, as any other Ships may. A dark Night or a Fog may give the blocked up Ships an Opportunity to get to Sea unseen. Besides, our Admirals and Captains are Men, and may be overcome with continually being exposed to Storms, &c. upon a dangerous Shore possessed by an Enemy.

I hope the risking our Ships, and the great Expence to keep so many Ships so long employed before the Ports of France, sometimes to little or no Advantage, will plead Excuse for my presuming to give the few following Hints, where *with* some Hope they may put Men of Capacity and Power

P R E F A C E.

vii

Power upon thinking of new Ways and Means to accomplish the great End in View (*i. e.*) to humble our Enemies, that they may not be able to disturb the Repose of Europe, so much as they have hitherto done.

In the second Place I have shown how to build dwelling Houses, which Women and Children may defend against a considerable Party with small Arms; which Sort of Houses may be of great Security to our out Settlements in America, and for which Purpose they are chiefly designed.

In treating of Building defensible Houses, I have omitted to mention that in Countries where it Snows much, and the Wind blows the Snow in Quantities against the Sides of Houses, Walls, &c. the defensible Houses in such Countries must be built upon Pillars of Stone, Brick or Timber, secured as well as can be done from Fire with dead Sap, Plaistering, &c. if neither Stone nor Brick can be had; so that the Wind have a free Passage under the House, that the Snow may not lye high against the Walls, and render the House surpriseable in at the Windows, high Doors, &c. It may be said Indians may get under the House and cut down the wooden Pillars, or make Fires to burn them; and if the Pillars are Stone or Brick, large Fires may be made under the House, which will burn it down. I answer, there may be made Places to pour Water down upon the Fire, and Places of Defence

Defence (like close Quarters in a Ship) that any one may be instantly killed that presumes to come in under the House ; besides Palisadoes may be round the open Place under the House, that a Man cannot get through between them, and yet be open to let Wind pass sufficient to blow away the Snow. *and I shall know*

I was put upon this Sort of Fortification by reading the Account of a Man's Wife and Children being carried away by the Indians, and some of them cruelly murdered. An Abstract of this Account is in the Appendix at the End of this Book.

I have deviated greatly from the common usual Method of Fortification ; being somewhat positive better Methods may be adopted. How far I have succeeded in my Search after better Methods of Fortification, the following Sheets will show.

The Manner of Fortifying here proposed is somewhat more expensive to build than the Methods hitherto used ; but that is more than balanced by these new Works being much stronger and defensible with smaller Garrisons.

I have not given a Construction, by Words at length, of the Methods of Fortification contained in the following Sheets ; thinking it superfluous, as the Plates are done by so large a Scale that every Part may be exactly measured ; and as

there

there are Profiles to every Plate (that cannot be well understood without them) the whole is easy to be understood.

That Fortification has not been much improved in many Years past, is owing, I think, to sound Theory and Practice being seldom found in Persons of such Rank and Credit as are generally imployed to fortify Towns: And if some ingenious Man, by great Application in a low Station of Life, does sometimes attain to sound Theory along with Practice, he seldom has the Means to make his Abilities sufficiently known to the World; for all the Endeavours, a Man in low Circumstances can make Use of, to get into a Station where he can make Use of such Abilities as are here meant, are easily baffled by superior judges.

What I have said of Foundations and Walls, is deduced from the Practice and Experience of above Thirty Years, in almost all Kinds of Foundations and Walls, both in the Sea and on dry Land. It may seem to some Readers almost impracticable to construct a Machine to lower Pieces of Masonry of about forty Tons, which I have spoken of in treating of laying Foundations in the Sea: But in the first Place it ought to be considered that it is much easier to lower forty Tons, than to raise so great a Weight; and there cannot be so much Difficulty and Expence in making a Machine to lower Forty Tons, as
would

x P R E F A C E.

would be requisite to construct a Machine to raise Forty Tons.

With Regard to Arches, I have only endeavoured to fix their several Thicknesses or vertical Length of the Key or Arch Stones, in Proportion to their different Widths between their Springers.

At the End of this Book I have a written a few Pages upon a Question which has been much controverted (*i. e.*) Whether a large Receiver, such as Jarrow's Lake in the River Tyne, up a River a Mile or two, more or less, from the Sea, doth or doth not (cause the Water to come into that River with so much a greater Force than if the River was near of a Breadth all the Way to the End of the Flux as to) cause the Water to raise higher ten or twelve Miles, more or less, up the River, than it would do if there was no such Receiver as above; and by this Receiver not only holding a great Quantity of the Flux itself; but being also the Means of more Water being deposited ten or twelve Miles up the River; I say if it is demonstrable, a large Receiver near the Mouths of Rivers, has these Effects, the Receivers are in Fact the Cause of keeping the River's Mouths more open for Ships to sail into and out of such Rivers; and are also the Cause of the River's being navigable further up into the Country; and consequently to lessen such Receivers must be injurious to the Navigation of Rivers.

T H E



T H E

C O N T E N T S.

- Chap. I. *Of the Construction of reconnoitring Boats*
Page 1.
- Chap. II. *Of the Construction of Boats for landing
and embarking Troops on an Enemy's Coast* Page 3
- Chap. III. *Of Vessels proper to protect Troops while
landing* Page 5
- Chap. IV. *Of joining three Vessels together, to be
of a sufficient Force for carrying large Cannon, both
to annoy the Enemy and protect Troops in landing
or embarking, when the Water is smooth and shal-
low, as mentioned in the last Chapter* Page 8
- Chap. V. *Of divers Inventions : and first of rol-
ling Breast-Works to serve as Parapets, &c.* Page 10
A short Account of these rolling Breast-Works Page 12
*Of the practical Construction of high Batteries made
with rolling Breastworks* Page 15
- Chap VI. *Of scaling Ladders* Page 17
- Chap. VII. *Of a Bridge to cross a Ditch, whether
dry or full of Water* Page 19
- Chap. VIII. *Of the Advantage of Feints in land-
ing Troops, &c.* Page 23
- Chap. IX. *Of real Attacks : And fitting old Ships
of War in a different Form, after they have been
condemned as unfit for Service in the common Way*
Page 29—40
Chap.

- Chap. X. *Of the fitting old Ships of War to lye
end on, and to batter Castles, Forts and Batteries*
Page 46
- Chap. XI. *Of small floating Batteries to batter an
Enemy's Castles, Forts, &c.* Page 49
- Chap. XII. *Of the Utility of old Ships of War,
when fitted as described in the IX and X Chapters*
Page 54
- Chap. XIII. *Of the means Britain has to take or
demolish an Enemy's Sea-Ports, and destroy their
Ships in Harbour* Page 63

PART II.

- Chap. I. *Of Fortility* Page 73
- Chap. II. *Of new Methods to fortify Places* Page 79
- Chap. III. *Of a new Method to fortify re-entering
Angles* Page 96
- Chap. IV. *Of fortifying a Circle* Page 101
- Chap. V. *Of a new Method to make Covert-ways
and Walls in fortifying Places* Page 115
- Chap. VI. *Of Foundations, and the Manner of
laying them in Fortifications, Bridges, and Piers for
Harbours* Page 122
- Chap. VII. *Of the Length of Arch-Stones* Page 164
- Chap. VIII. *Of Rivers, Creeks and Harbours;
and making proper Use of the Flux of the Sea*
Page 170

APPENDIX.

- Chap. I. *Of manning the British Navy with less
Grievance to the Subjects* Page 182
- Chap. II. *Contains a Scheme to employ Seamen;
and also treats of a Copper-mine near Hudson's
Bay; and of a Scheme to discover the North-west
Passage, or determine there is no such Passage;
with Cautions and Directions.*



T H E
BRITISH MARS.

C H A P. I.

Of the Construction of reconnoitring Boats.



BOATS for this Service should have much the same Length as a Man of War's twelve oar'd Barge; but should be at least a Foot broader, with a flatter Bottom, and of a very light built, so as to carry Ballast enough to make them bear a larger Sail than common, at a very small Draught of Water. The Thickness of the Keel should be such as to admit of two Mortisises through it, from the upper to the under Side, the one forward, the other aft, each about the quarter of her Length from the Midships; but the forward one rather more so than the other. These Openings to be each between three and four Feet long, and about an Inch and three quarters wide; and should be continued as high as the Thwarts, by making a strong Case, to contain a Plank or Lee-board (well secured with Iron) to be let down or hawled up at pleasure,

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when the Boat is under Sail, in order to make her hold a good Wind.

In going about (when under Sail) the Lee-boards may be plucked up the Instant the Helm is put a Lee, and let down again as soon as the Boat begins to pay off.

As it is a principal Point that such a Boat should be constructed in the aptest Manner to row well in case of Pursuit, &c. The Thowles or Rullocks must be so placed, that the Purchase of the Oars may be taken at least a Foot without the Gunnel, for by this Means the Oars may be longer, and give the Boat better Way with less Force.

Another Artifice for helping to make good Way, will be to form a Hole or two in her Stern, for letting through Poles of a convenient Length, with artificial Swan Feet at the outward Ends, to contract when hauled inward, and to expand when pushed outward: by working these, as Occasion may require, a considerable Degree of Velocity will be added to the Effect of the Oars.

And lastly, it may be of some Advantage to raise a Standard in the after Part of the Boat, just clear of the Oars; to the Top of which is to be fastened a Rope with a Hook at the lower End, on which may be readily hung a Weight of a Hundred or two, more or less, as may be found most convenient in practice; and a Butt being fixed about the Height of the Thwarts, let a Man in the Stern hawl aft the Weight, and at every Stroke of the Oars, let him take good Care to dash it against the Butt, which will be found to quicken the Boat's Way.

N. B. It will be necessary to cover both the Butt and striking Face of the Weight with some proper Material, for preventing too great a Jarr.

C H A P. II.

Of the Construction of Boats for Landing or Embarking Troops on an Enemy's Coast.

SUCH Boats should be about thirty Feet long, and near twelve Feet broad, and flat Bottomed, built with a Flooring of pretty thick Boards, so as to endure beating against the Shore, but as light as possible at Top, so as not to draw above eighteen Inches or two Feet Water at the most when loaded; both Ends should be nearly a like, and a little rake-ing. In the building they ought to be so contrived as to part in two, length ways, and be united again with little Trouble or Loss of Time; the Execution of which must be left to the Builder's Discretion, the Intention thereof being for the Conveniency of Stowage on Shipboard. Thus by making three or four Sizes gradually diminishing, they may be stowed in little room on each Side the Ship's Quarters, (like *Hambrough* Boxes cut in two length ways) one within another, one half on one Side, the other half on the other, so that a Transport may carry as many as will land or imbark all her Soldiers at once*.

It will be easily apprehended that the Hooks fore and aft, the Floor Timbers, and the Thwarts, are not to be fastened, but only sayed, till the Boats come to be put together; yet in order to do this, every Piece must be bored off ready, and fitted with skrew Bolts and Nuts, instead of Nails and Treennails, with a Provision of tarred Canvass or Flannel, to slip between the two half Keels, Stern and Post,

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* Being able to land all the Troops at once will be of great Service in many Respects, as will appear when Landing of Troops are treated of.

in order to make her Water tight upon being rejoined; I recommend both Ends to be formed alike, that either End may go foremost to prevent winding, either in going ashore or coming off; the Thwarts ought to lie as low as possible, and the Rullocks to be placed fifteen or eighteen Inches without the Boat's Side, as in the reconnoitring Boats, under which long Poles or Sets may be carried, to help to push the Boats a head in shoal Water, when it blows too fresh for the Oars to do it.

Upon the End of the Boat which is to be next the Shore, or Enemy, there ought to be a Breast Work of two Feet thick, or more, consisting of light Materials, in the manner of a Pack or Roll quilted strongly together, which, for the more convenient Stowage in the Bottom of the Boat when the Wind blows fresh a Head, may be made up in short Lengths, with several Loops or Nooses in each, to cord them fast together when they are to come in use. This Breast Work, thus put together, and fixed in the Boat, will cover the Men from the Enemy's Fire, in advancing to, or retreating from the Shore. A more compleat Description of these Packs or Rolls may be met with in Page 12.

For the common Defence of each Boat there should be provided ten or twelve Muskets, with large Barrels of well forged Iron, fit to carry a single leaden Ball to a good Distance, or small Grape Shot in case the Enemy be near. I prefer a leaden Bullet to an Iron one, on the following Account; one of lead of an Inch diameter being much heavier than an iron one of the same Dimentions will consequently be driven with equal Force to a greater Distance.

The Muskets, in order to distinguish them from others, may be called Artillery Muskets; as each Boat will be near twelve Feet wide, five or six of the Muskets being fitted, each with a Swivel sharp pointed,

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ed to slip readily into Holes made for that Purpose on the Top near the Inside of the Breast Work, may be fired at once, whilst the like Number are loading, to be slipt so readily into the Places of those just discharged, that a constant Fire may be kept from every Boat, so as infallibly to annoy the Enemy, and keep them at a much greater Distance than can possibly be done by the common Muskets.

C H A P. III.

Of Vessels proper to protect Troops whilst Landing.

VESSELS of fifty-five or sixty Feet long, and very broad, must be so contrived in their Construction, that with a very little Draught of Water they may be able to keep the Sea in bad Weather; and serve as Tenders, &c. when not otherwise employed; but if the ingenious Ship-builder should find himself at a Loss to give a Vessel these two Properties, though fitted with Lee-boards like the reconnoitering Boats, the common Construction may answer the End, by the Addition of a counter Bottom, consisting of four Parts or Quarters, and to be provided whilst the Ship is building, occasionally to fit and take off from the Vessel's thin Parts, in the Nature of a Camel, forming a quite flat Bottom, like that of a Barge, when fitted on, to bring her to a small Draught of Water. Such counter Bottoms may be brought under Vessels, and fastened to them with ease when the Water is tolerably smooth, after the following Manner; first hawl the Vessel along side some Ship and lighten her as much as possible; then heave out the Quarters of the counter Bottom, and fasten them together two and two, with the strong Chains fix'd ready for that Purpose; this being done,

sink them*, till the Chains can pass under the Keels of the Vessels, either forward or aft, and hawl them to the proper Birth to which they were adapted, where fasten them with skrew Bolts or the like Contrivances for that Purpose, so that the Parts may meet and butt each other about the Midships, and be secured in that Position†.

It is necessary that such a Vessel should have two Decks very well supported, and at least five Feet and a half in height between Decks, that there may be convenient Room for Capstanes between Decks, and more especially for Oars to row in failure of Wind, and the better to keep her Head toward the Enemy, when within reach of their Shot.

As the Nature of the Service requires that these Vessels should be very stiff, and draw but very little Water when they have their Guns and Men aboard, it

* These counter Bottoms may soon be cleared of Water, by means of a Tube about nine Inches or a Foot square, and fifteen or twenty Feet long open at both Ends, made of Oak or Fir Plank, about one Inch and half thick, with a convenient Number of Valves in the upper Side, (this sort of Pump lying in an inclining Posture when in use) with a light Frame of Brass or Iron that fills the Tube, and has large Valves to fly open easily, when the Frame touches the Water. This Frame should be fastned to a Pole about two Feet longer than the Pump, and one or two Men working the Pole push the Frame to the Bottom of the Pump, the Valves open and let the Water continue in the Pump, as deep as the Pump is emerged, and as they attempt to hawl the Frame up the Valves shuts, and they hawl all the Water up that is in the Pump above the Valves.

I made some of these Pumps of such a Size, that every Inch in Depth contained a Gallon; one of them being emerged eleven Feet, six Men made eight Strokes in a Minute, which drew up above four Tons of Water.

† Vessels ordered after this Manner will endure a swell or gentle Summer Sea, and lye near the Shore with Cannon to annoy the Enemy and keep them at a Distance.

it will require a due Consideration to construct them; because the Vessels must be made able to carry their Cannon high, which may be six in Number, pointing forward, or aft; but as the Breadth of the Vessel will not at the utmost admit of more than three large Cannon to point forwards, it will be necessary to plant them in two Tiers toward the Midships, at a proper Distance behind each other, and the fore Tier to be about four and a half or five Feet below the after Tier, that the after Cannon may fire clear of the fore ones.

For the better Security and Defence of the Men, strong Parapets of Junk and other Materials may be provided, ready framed in short Lengths for the better Conveniency of Stowage in the Hold when out of use, to be ready at any Time to be placed in their Births upon the Decks before the Guns, in a sloping Position; whereby the Enemy's Balls, though shot from a higher Battery, will strike the Parapet with only a small angle of Incidence, without taking any considerable Hold of it, and consequently will glance and be reflected upwards*.

These Vessels being to fight their Cannon lying with their Ends to the Shore, it may perhaps seem as a Matter of some Difficulty to keep them from casting a thwart, but this may be effectually prevented, by strong Stakes shod with Iron, so contrived as to be let fall into the Ground on each Side the Vessel close aft, and to be taken up again at Pleasure, through Holes wrought

* The higher a Vessel carries her Guns. the greater Advantage has she in annoying the Enemy's Troops, as she has a better Command of rising Beaches, which frequently at low Water cover the Boats from the Enemy's View. And if the Water is smooth where the Troops are designed to be landed, such Vessels may be of excellent Service, by two or three of them being fastened together, as shall be explained in the next Chapter.

wrought in her Bottom for that Purpose when building, on each Side near the Vessel's Quarters, and as far aft as can be*.

C H A P. IV.

Of joining three Vessels together, to be of sufficient Force for carrying large Cannon, both to annoy the Enemy and protect Troops in landing or embarking, when the Water is smooth and shallow, as mentioned in the last Chapter.

THE ingenious Shipwright is here again to be informed, that a third Property will be requisite in the Vessels treated of in the forgoing Chapter, in order to make them answer our further Purposes; namely, that they be formed strait or Wall sided, in order to lye close along side each other, when two or three of them are fastned together; but as I am somewhat suspicious that it will be scarce practicable to construct Bodies which will answer all these several Ends thoroughly, I should rather advise, considering that the Expence will be trifling, when compared with the great Advantages resulting from them, that Vessels be built on purpose, of about the same Dimensions as those last treated of: for example, sixty Feet

* It may be presumed that it will seldom be attempted to land Troops in a Sea that will not admit of Boats full of Men to go ashore with Safety; in a moderate Sea the rising of the Vessel will not lift the Stakes out of the Ground, but the Vessel will slip up and down the Stakes by the Action of the Swell, and an Anchor out to Sea will secure her from thwarting. If on the ebb Tide the Vessel be in danger of grounding, the Stakes may easily be hove out of the Ground by the Capstans and Pulleys fixed between Decks, and when she is hawled into deeper Water, the Stakes may be let down in a Moment.

Feet long by twenty broad, the same Height between Decks, with Row-Ports, with counter Bottoms to make the Bottom flat, and a straight upright Skie, especially from the light Water Mark; the Ends fore and aft somewhat like the Society's Herring Busses, and to be rigg'd with a light Mast, something after their Manner, or any other that shall be judg'd most convenient to put in or take out at pleasure: Each of these Vessels ought to have six square Openings on each Side, nearly at equal Distances, a very little above the light Water Mark, and six more like Openings close below the upper Deck Beams, with Trunks to the low Openings, made tight to run from Side to Side, and firmly secured, so as to be fit to receive strong Beams of Timber that shall run thro' the two or three Vessels to fasten them securely together, for the Use and Purposes hereafter mentioned.

In order to put these Vessels together, in the first Place, if three are to be put together, let the middle one receive two of the aforesaid Beams, through the forward and the aft Openings, and next let the other two Vessels receive the Ends of the Beams, each in at their Sides; these two alone will be sufficient to keep the three Vessels in equal Motion, and to facilitate the Introduction of the rest of the Beams; after they are all fix'd right in their Places, unrigg and take out the Masts, Sails, &c. of the two outside Vessels, leaving the middle one rigged, that some Sail may be used if Wind offers. Fasten them altogether with Chains across their Bottoms fixed for that Purpose; thus they will be able to carry the heaviest Cannon on their upper Decks, eight or ten Feet high above the Water; and in case the Water be quite smooth where the Vessels are to be employed, a higher commanding Battery may be raised above
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the former*, supposing such to be at hand in the Vessel, ready framed to be put up and taken down at pleasure; instead of a Parapet upon these commanding Batteries, place small upright iron Stantions six Feet long, upon which hang a Quilt of woollen Rags, or other Matter, Musket proof, with small Pieces to lift up and form Openings for the Cannon to fire through, and fall down again to stop Musket Shot from the Enemy whilst the Cannon are re-loading; the importance of these sorts of Batteries will better appear when we come to explain the Manner of Landing†.

C H A P. V.

Of divers Inventions; and first of rolling Breast-Works, to serve as Parapets, &c.

THE rowling Breast-Works here proposed, may be made of any sort of Materials proper to resist or deaden the Motion of Shot; such as old Quilts, Raggs, or woollen Cloths of any kind that will come cheap, which may be, for the better Convenience of folding together, wrought up into Plat or Cordage; take a Balk of Timber of the Length of each Parapet,

* These commanding Batteries, in smooth Water, will be of great Utility, as they will have a great Command over the Enemy's Situation and Works ashore.

† Two or three of these Vessels being fixed together, it may be easily tried how high they will carry a Battery of any Number of Guns of given Sizes, by raising several strong Sheers on the Decks, and heaving the Weight of the Platform, Guns, &c. up a considerable Height, making Trial at several Heights, after every Thing is well fastned, and then by Means of Ropes at the Top of the Sheers giving the Vessels the like Motion as in a moderate Sea: This should be done before the commanding Batteries are framed.

pet, at the Ends of which fix strong iron Gudgeons to receive a Frame convenient for the Men to convey it, either to hawl it after, or push it before them; this Frame may have Spikes so hung to it as by their Ends trailing upon the Ground to hinder its running backwards, when pushed or hawled up Hill, or its recoiling when struck by Shot; at each End of the Timber Balk or Beam, fix Spoaks of Iron, like those of a Wheel, to keep the Wrapping regular; then fold the woollen Rope or Plat round the Balk (which should be straight for rolling Parrapets, but crooked and small for those at the Bows of Boats) taking Care to fix Skewers of Wood or Iron in many Places of the Roll, to keep the Wrapping well together, which for further Security, may be at last covered with a strong Netting of hempen Rope.

Rolling Breast-Works of different Forms and Sizes, thus compacted, will answer the different Purposes of stuff'd Gabions, Corbels, Fascines, Earth-Bags, Mantlets, or any other Contrivances for covering the Men from the Enemy's Fire in attacking Fortresses; as will better appear hereafter. They will also, with the help of a light Covering of Tarpaulin, Leather, or other durable Materials, make excellent Rafts, to carry and land any heavy Weight, as Cannon, &c. and may be rendered very fit, if due Care be had to the Covering, for erecting floating Batteries upon them; for if they be kept dry, and not very hard worked, they will swim more than half the Diameter above Water; but great Care must be taken not to let them get thoroughly wet, because then they will only float by the upper Surface, and if twisted or made very solid, will resist Cannon Ball better than any other Materials I know of that will swim.

A short Account of the Use of these rolling Breast Works.

SUPPOSE a Debarkation intended at a good and advantageous Landing-place, but where great Opposition is expected, the Enemy having Cannon planted on Batteries, and Works thrown up, not only near the Shore to hinder the Landing, but also at a proper Distance has formed Redoubts, with other Batteries, and a Line of Communication, so that Cannon Shot from a Frigate or other small Vessel, lying at a common Distance from the Shore, can do them but little Harm; Now though the Enemy's Cannon cannot reach the Frigate, no more than the Frigate's Guns can reach them, yet the Enemy's Guns may easily reach the Water Side with sufficient Force to annoy the Troops, both in landing and when landed. Indeed, if such a Disposition be made by the Enemy, and they perform their Duty well, it is impracticable to land, according to the common Method, without considerable Loss. But supposing rolling Breast-Works provided, twenty Feet in length, and six Feet in diameter, as before described; Rafts may be made of them by fastening five of them together to every Raft, which Rafts will consequently be thirty Feet long and twenty broad.

Across the five Rolls so lashed together, lay strong Planks, thirty Feet long, to make them bear alike in the Water, with other Planks twenty Feet long, and two or three Inches thick, across these; thus there will be formed a good Platform for Cannon to rest or recoil upon, should there be Occasion for firing from the Raft; some of these upper Planks should have Irons fixed near their Ends, fitted to receive and hold fast other Rolls of six Feet diameter, to serve for a Parapet to cover the Men from the
Enemy's

Enemy's Fire, whilst Landing, or firing their own Cannon *.

Being furnished with a sufficient Number of these Rafts, any Body of Troops may approach the Shore under a good Defence; having at all Events a sufficient Number of Cannon to answer those of the Enemy; but should there be no Need of firing the Cannon at Sea, the Rafts may be pushed ashore about high Water, or upon the Ebb†, and when the Fore-part is laid a-ground, sufficient Planks must be laid from the Rafts to the Shore, and the Parrapet Rolls rolled off first, and plac'd in proper order on the Shore or Beach, and the Cannon landed next and brought up to the Parrapets, all which may be so quickly dispatched, supposing the Water smooth, that in about half an Hour, from many such Rafts, an Hundred Cannon may be landed and made ready for Action, covered with the rolling Breast-Works, under which the Troops may advance in tolerable Safety, to attack any Place or Enemy, with as many Cannon as may be judg'd proper, whereby such Advantages may be gained as will reasonably assure Success with very little Loss.

If a great many Cannon should be wanted ashore, each Raft will be able to carry four ready mounted, besides

* Rolls of six Feet diameter, and not too hard work'd, will float near three Feet and a half out of Water before any Thing is laid upon them, and twenty Tons will sink them about twenty-three Inches more; wherefore each Raft will carry about twenty Tons, and at the same Time bear the mounting a Battery of two Guns in front, in smooth Water, or when there is only a moderate Swell.

† The Re-action of the Sea will prevent their taking the Ground where the Sea has a considerable Declivity, therefore strong Ponies like them used to cramp and manage West Country Barges upon the *Thames*, must be ready upon the Rafts to confine them to the Shore.

besides the two for immediate Service; and the Raft being taken asunder, and landed, will be resolved into four rolling Breast-Works or Merlons, for the four Cannon, besides the two that were ready for Action upon the Raft. Thus each Raft will be able to land six Guns, with all their Equipage, which when on Shore will make a Battery of six Guns, with all requisite for Service in a very little Time; so that ten Rafts will furnish Batteries for sixty Pieces of Cannon, and carry many other Necessaries ashore besides; one Raft alone would carry the Weight of ten, but would furnish Materials for no more than six; and if it is apprehended that the Cannon on the Rafts will be much used in firing against the Enemy, it will be proper to have two or three other Rafts to carry the Cannon, &c. on Shore, for Shore Service.

By these Helps, and a proper Use made of these Vessels as before directed, Troops may land at any Place in fine Weather, and even have the Advantage of the Enemy, though superior in Number; for these Rolls will form into Batteries so very expeditiously, that an Army of three or four Thousand Men, once landed, may advance with fifty Cannon in Order of Battery a Mile or two, in five or six Hours from landing, the Rolls sufficiently covering their Front, so that they will never be at a Loss to fight their Cannon under Cover, should they be suddenly attacked on their Way by the Enemy.

High Batteries may also be raised in a very short Time, by setting a Number of large Rolls on End, and binding their upper Ends together with Ropes provided

* I make no Mention of Horses, because all or most of these Rolls will be too cumbersome to be drawn by them from Place to Place to any great Distance, they being chiefly adapted to Coast Fighting (where Shipping can carry them near to the place of Action) where many Horses for that Use would be inconvenient.

provided for the Purpose, throwing up Earth against their lower Ends to make them stand the faster; at the same Time shorter Rolls of six or seven Feet Diameter should be ready for a Parapet or Merlon, between every two Guns, with flat Pieces to form the Embrasure, and fill them to the Top if needful.

To make the Platform for working the Cannon upon in Time of Action, lay three Inch Planks, not very close to one another; the whole Length of the Batteries, and cover them with others about seventeen or eighteen Feet long, laid across close to each other, and then the Cannon will recoil and traverse easily over them.

Of the practical Construction of these high Batteries.

HAVING fixed upon the Spot of Ground, roll a sufficient Number of Breast-Works between it and the Enemy's Fire, to prevent their Shot from annoying the Men while at work; make the Ground plain, and, if it can be effected with a little Labour, let it lower away gently towards the Object that is to be battered, that the Top, on which the Cannon is to recoil, may have a Descent towards the Embrasures; then set a Number of Rolls on their Ends, to form a Rampart about twenty-eight Feet broad, upon the Top, for which four Rolls of seven Feet Diameter, set on a Row, will suffice; the Length must be suited to the Number of Cannon intended to be planted upon it; allowing about sixteen or seventeen Feet of Length, to each twenty-four Pounder.

Now as the Parapet is to be made of Rolls, it will be necessary that the Rampart should be hallowed along the Front, to cause it to lie firm upon it; and this may be effected by making one Side of each of the outside Rolls that are to make the Rampart,

a Foot shorter than the other; for if the two shortest Sides be placed parallel to each other, and next the Front, a Hollow will be thereby formed in the Rampart, so as to make it hold the Parapet Roll fast.

After the upper Ends of the Rampart Rolls are lashed firmly together, a good Quantity of Earth must be thrown up against their Bottoms, to make them stand fast, and then the Parapet Rolls must be rolled up and properly placed, having about twenty Inches Opening between each two Rolls for an Embrasure, and fitting in the Madriers at the same Time to prevent the Enemy's Shot from passing through the Embrasures. The Madriers is so well known as not to need any particular Explanation*.

When all Things are in readiness for laying the Platforms, begin with laying three Inch Planks stretching along the Rampart made of Rolls, whose Ends must butt or meet in different Places upon the Rampart; then lay other Planks, two Inches thick and eighteen Feet long, across those already laid, for the Guns to recoil upon.

Another singular Use of Rolls will be to roll along before Cannon that are advancing to cover or form an Attack; for it is easy to conceive that by the Means of such rolling Breast-Works, any Number of them may be pushed forwards under sufficient Cover as near an Enemy's Fortification as is necessary.

When a Breach is not intended to be made, six or nine Pounders, mounted on travelling Gun Carriages, will be sufficient, with rolling Breast-Works well soaked in Water between each Cannon, and a square

* The Ends of the Rolls which are to form the Parapet, ought to be beveling, in order to make the Embrasure widest on the Side next the Object intended to be battered.

square Madrier of the same Materials to fill as high as the Cannon, the Space between the rolling Breast-Works in time of Action; on a March the Madriers are to be hung to the fore part of the Guns, to secure the Carriage from the Enemy's Fire, upon which other Madriers are to be laid to fill the Openings between the Breast-Works to the Top when needful, thus during the Advancing of the Cannon, the Men who work them will be covered with a good Breast-Work.

When the Cannon are to be conducted a greater Distance, they may be fitted in the Manner following: If there is any Apprehension of meeting an Enemy in the Field; let Iron be fixed to the Axle-tree of the Carriage, of Strength sufficient to support an Iron Bar of twenty Feet in length, lying across, a little before the Muzzle of the Gun, and about six Feet in height from the Ground, on which to hang a Mantlet, Musket proof, with a small Piece of Mantlet to cover the Mouth of the Gun, which may be put aside when it is to be fired; the Mantlet extending about eight Feet on each side the Carriage, will cover the Men that push the Cannon forwards, as well as the Musqueteers that march with the Cannon. The Cannon, when marching in the Face of an Enemy, must be pushed forwards by means of Trails upon small Wheels fixed behind them, with Traces for the Men to hawl them by; thus a number of Cannon may be made to advance and face an Enemy to some Advantage, especially against small Arms.

Since these rolling Breast-Works must be of great Importance to that Power which is Master of the Seas, in the whole Progress of distressing an Enemy's Sea-Coasts; I would earnestly recommend them to my Reader's thorough Consideration, for it would be tedious where Brevity is intended, to

expatiate further on the many Purposes to which they are capable of being applied.

C H A P. VI.

Of scaling Ladders.

PROcure the longest Poles that can be got, of two Inches and three Quarters in diameter; Ash is the Wood which is most eligible, but as they should be thirty, or five and thirty Feet in length, which *English* Ash seldom runs to, clear of Knots, young Fir Trees may serve the Purpose, for Poles sawed out of Timber will not be so proper, as not being so tuff and strong. The middle Part of these Poles ought, as I observed, to be two and three Quarters of an Inch in diameter, but they should be somewhat tapering towards each End; when these Poles are to be converted into Ladders for service, two of them must be set parallel at a proper Distance asunder, and kept so by proper Iron Work that will not damage them; round Loops or Sockets at each End of the Bars, to put on upon the Poles, seem likely to answer this Purpose best, and they may be fastened at the Ends by Skrews. The Steps of these Ladders should be small Ropes, stretched transversely between the Poles, their Height one above another should not exceed one Foot; they might indeed be eighteen Inches Distance, but then a Man must be obliged to give a Spring every Step that he ascends, and this would require a stronger, and consequently a heavier Ladder.

Such a scaling Ladder, wide enough to hold two Men a-breast, and thirty or thirty-five Feet long, will admit of six Men upon it at a Time, and the Ladder not weigh much above one Hundred

dred and twenty Pounds: It might perhaps be expedient to have a small Pole fixed with its End about ten Feet from the Top of the Ladder, to be in readiness to raise the Top when necessary.

When the Ladders are out of use, the Poles will lie almost as close together in a Ship as so many other Poles, for the small rope Steps will be a very inconsiderable Hindrance to their Stowage.

Another sort of Ladder may upon trial prove more useful in the open Attack of a Place by Escalade, in a new Manner hereafter described.

This Ladder ought to be about forty Feet long, and made of good Rope, with a proper Chain about twenty or thirty Feet long, properly fastened to the End of the Ladder that is to be uppermost; and to the other End of the Chain let a Ball of nine or twelve Pounds be well secured, so that the Ball may be fired out of a Gun and draw the Ladder after it across the Ditch, and fix it to its Place by the Ball plunging a good Way into the Defences of the Place, drawing the Chain in after it.

Considering the great Advantages that might accrue, especially to *Britain*, from a right and ready Manner of attacking Places by Escalade, it may be worth while to exercise the Soldiers at home in time of Peace, in this important Part of Military Operation. It will require Experiments to discover rightly how to make and use this Ladder.

C H A P. VII.

Of a Bridge to cross a Ditch, whether dry or full of Water.

GREAT Ditches are usually made from ninety to a hundred and twenty Feet wide, more or less; those of Out-Works from about fifty to seven-

ty Feet, but as the precise Breadth cannot always be obtained, it will in this Case be necessary to be provided with two Bridges, one longer than the other; the longest with folding Parts, to cross from fifty to eighty-four Feet wide, and both Bridges together to secure the Crossing from the Breadth of ninety to an hundred and thirty Feet; the Bodies of these Bridges are to go on a pair of Wheels, fixed at either End, each Wheel being about twenty Feet diameter, and to tread eighteen or twenty Feet asunder.

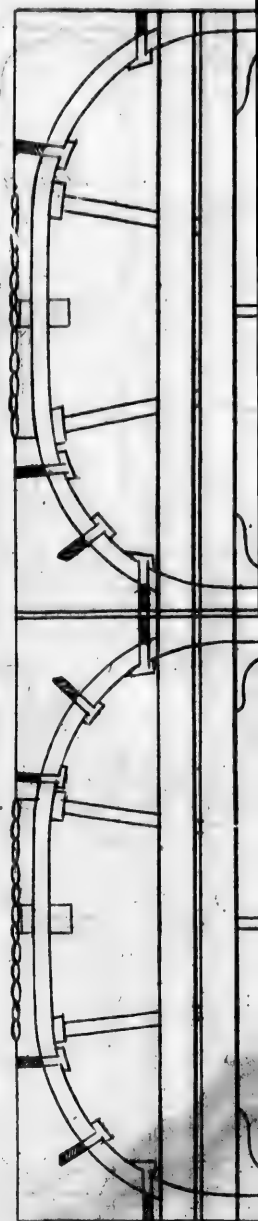
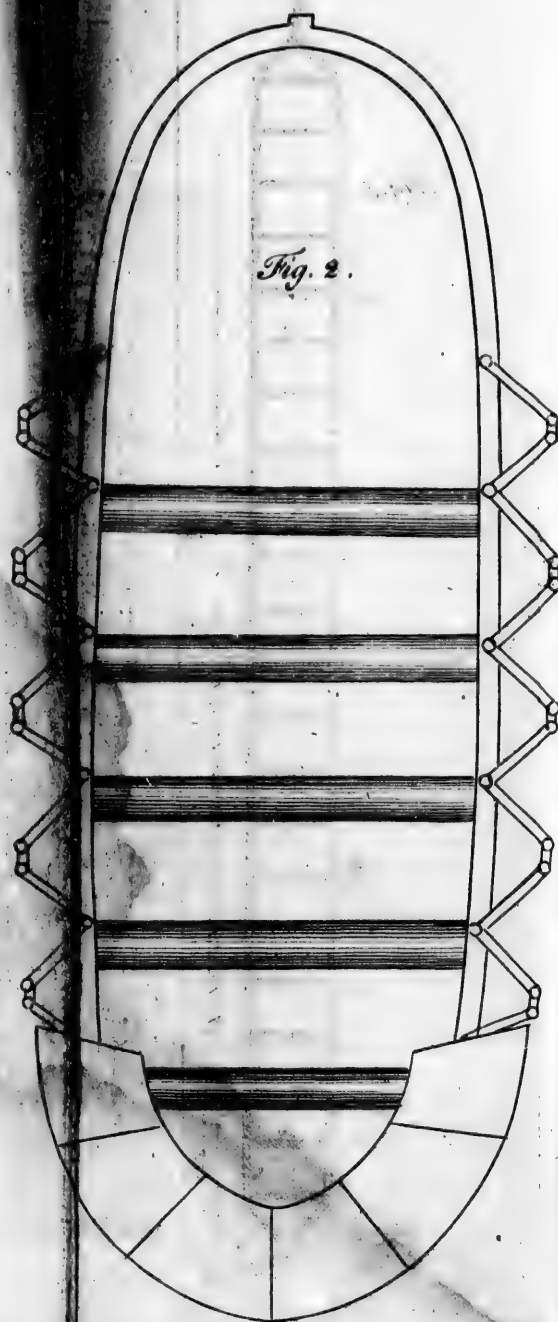
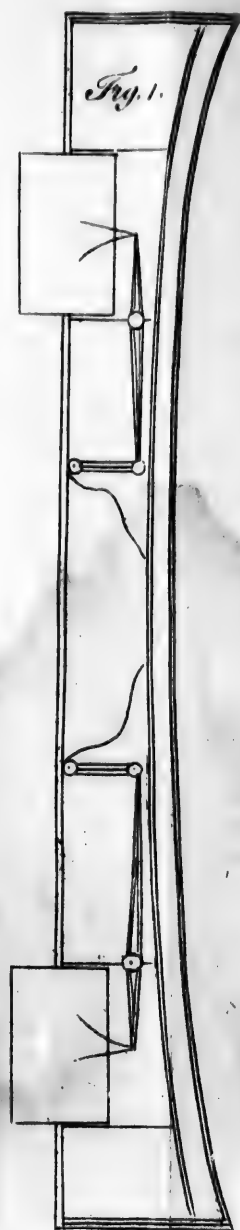
Suppose the Body of the Bridge which is to be pushed into the Ditch, to be thirty Feet long, from the fore Part of one Axle-Tree to the hinder Part of the other, which leaves the Semi-Diameter of each Wheel without any Bridge; and as it may be impossible to know the Breadth of the Ditch to a certainty, it will be adviseable to have in readiness thirty-eight or forty Feet of spare length of Bridge, to be used if necessary, which may be easily provided, by having a folding Part of thirty or thirty-five Feet long, fastened to the after Axle-Tree with strong Hinges, and its after End, (for the better Convenience of travelling) supported by Wheels ten Feet high, so that the Men appointed to convey it will have sufficient Room to hawl under the Bridge, and the Wheels may be taken away at pleasure, as soon as the main Body of the Bridge is pushed into the Ditch; and instead of the Wheels, the outer End of the folding Part may rest upon the covert Way, and by pushing forward or hawling backward the said main Body, the Bridge may be made suitable in length to the Breadth of the Ditch; and for the more convenient moving the second Bridge over it, (which should be narrower than the first) it would be proper to fix first a folding

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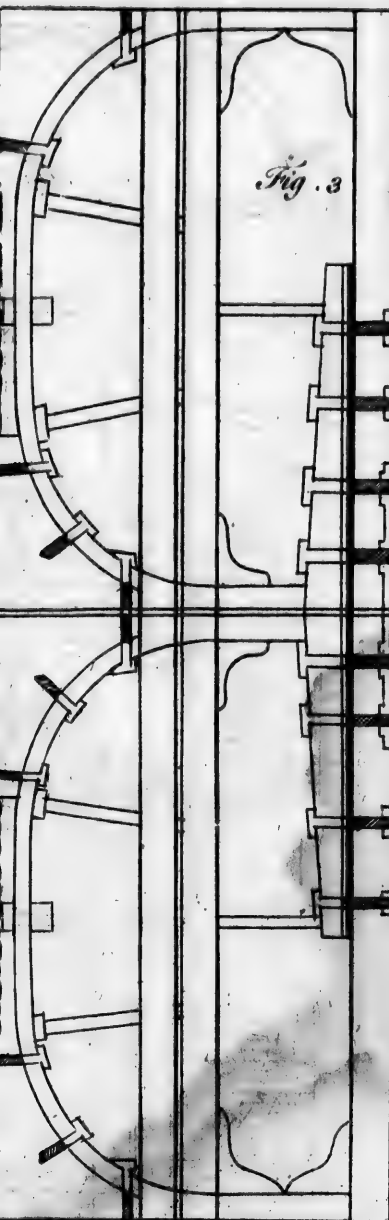


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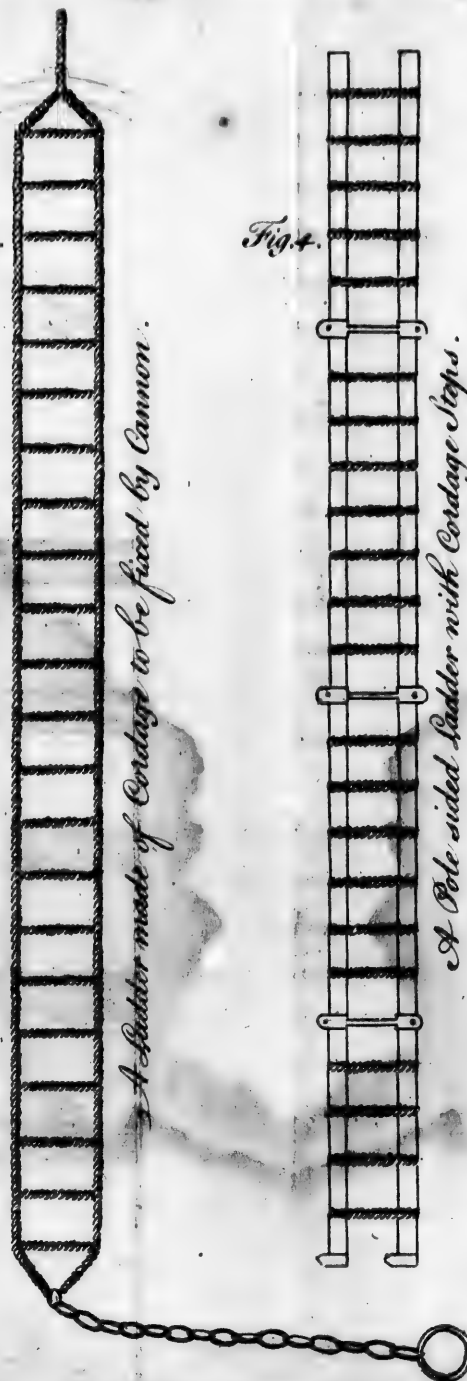
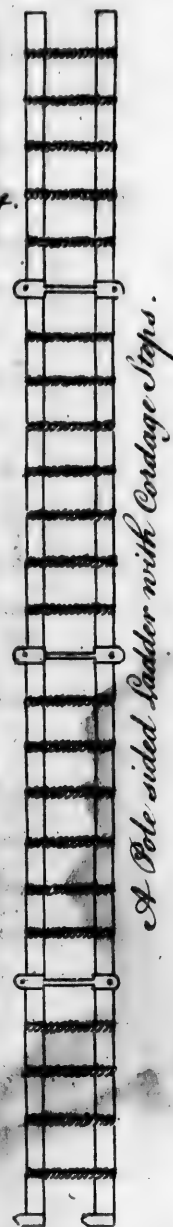


Fig. 5.

A Ladder made of Cordage to be fixed by Cannon.

Fig. 4.



A Pole sided Ladder with Cordage Steps.

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ing Part at the fore End of this second Bridge, of about twenty Feet long, to face the Ditch.

Suppose the Ditch to be one hundred and thirty Feet wide, or a little more, though few exceed such a Breadth, and not many are so wide, first push the Bridge as above described into the Ditch, till only two or three Feet of the after End remain upon the covert Way, which must be fixed down with three or four Iron Stakes, or well fastned with Ropes to the remaining Parts of the Palliades of the covert Way*: This Bridge will advance sixty or sixty-two Feet into the Ditch, and leave sixty-eight or seventy Feet of the Breadth of it, for the second Bridge to be pushed along the first already in the Ditch.

The main Body of the second Bridge, like that of the first, is understood to be thirty Feet long, with folding Parts at the Ends, each twenty or thirty Feet long, that at the after End to be supported by two Wheels, and the fore Part to be elevated to an Angle of about forty five Degrees, and kept so suspended with Chains till the Body be so far advanced into the Ditch, as that the after folding Part may reach about two Feet, more or less, on the Body of the first Bridge, which being already forwarded to the length of about sixty or sixty-two Feet into the Ditch, the after folding Part of the second Bridge will make twenty Feet more, and with its Body, one hundred and twelve Feet in the whole, whereby the foremost folding Part having no more than eighteen Feet of Ditch to cover, will reach a considerable way up the Parapet, and so be a Means of affording the Men an easy Entrance into the Place

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* These Wheels being twenty Feet high, will go over any Obstruction seven Feet high.

As Men are to be employed in drawing and pushing forwards these Bridges, Traces must be fixed under them (so that the Men will in some Degree be secured against small Shot) sufficient to contain as many, or near as many as may be sufficiently able to hawl the Bridge to the Edge of the Ditch; but as the Men cannot enter a deep Ditch full of Water, it will be necessary to have a Trail behind the Bridges, where a requisite Number may hawl and assist those under the Bridge, by which Trail alone the Bridge may be forced or pushed across the Bottom of the wet Ditch; for as the Bridge when emerged in the Water will be buoyed up almost to float, a small Degree of Strength, compared with what is necessary to push it on the Ground, will suffice to force it on when in a wet Ditch; and if the Ditch be dry the Men may do their Business in it.

In the Case of a dry Ditch, a Trail will not be absolutely necessary, unless the Distance the Bridge is to be advanced to, be very considerable.

It may happen that the Place may be alarmed, therefore Quilts, Musket proof, ought to be provided, to hang on each Side the Bridge, to secure the Men hawling under it from small Shot*. It is supposed the Barb Batteries are silenced before this Bridge advances near, if the Place is alarmed.

Although (as I have observed) Ditches are of various Breadths, two such Bridges as I have been describing will serve for crossing any Ditch from eighty-four to one hundred and thirty Feet wide, for if it be no more than eighty Feet, it will admit of the Bodies of both Bridges between the Scarp and Counter-Scarp, and the folding Part forward will lie against the Parapet of the Place, and that behind

* Such Engines are supposed practicable to be brought against Sea-Ports, but too cumbersome for in-land Service.

Behind will rest on the Covert-Way; The long Bridge alone with its folding Parts will command the Crossing of any Ditch from fifty to eighty-four Feet over, and how these two Bridges are to be used together in crossing one of one hundred and thirty Feet over, has been already explained.

C H A P. VIII.

Of the Advantage of Feints in Landing Troops, &c.

ALthough it be unquestionable that it is in the Power of *Britain* to attack any Place upon an Enemy's Coast with the greatest Probability of Success, when common Prudence and Reason encourage an Attempt; yet as the executing such Services with the least Loss will be the most commendable, the proper Use of Feints should be some Time had recourse to, for attaining this desirable End.

For Instance; suppose that it be determined to land in the Night Time, it will (I think in the first Place) be of Service to keep the Enemy ignorant of the Intention as long as possible, by lying at a good Distance from the Shore, if the Wind is favourable, or by any other Means, till the Afternoon, and then dispatch reconnoitring Boats to discover the best Landing Places, &c. (but it would be better if they were known before the Expedition sail from *Britain*) near the Place proposed to be attacked, attended by Frigates and Cutters, built on the best Plan to sail and row, and followed by the whole Fleet*.

Thus

* It has the Appearance of Negligence in the British Government not to be acquainted with the Landing Places upon the

Thus the Landing Places will be discovered for the Forces to make the earliest Use of them ; and as the Success of a Surprize or sudden Attack is much facilitated by assaulting the Enemy unexpectedly, the Landing should be conducted with the greater Care and Expedition.

Having considered the Landing Places with regard to the principal Object, it is natural to imagine the most advantageous Landing Places are most guarded, in order to prevent or obstruct a Landing there ; agreeable to these Conceptions I think it would be right to chuse a Landing Place a good Way from the Object, there to make a Feint to Land*.

If it should be thought proper to land in a very dark Night, Vessels must be laid in order to hang Lights out to direct Boats in their Course to the real Landing Place designed, but

If two Lights, as is common, are placed to be kept in one, in order to be a Direction to the Landing Place, the Enemy on the Shore will too easily understand it ; therefore I would recommend to have
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the Coast of *France*, especially the most particular Places. Though I am not well acquainted with the Behaviour of the *French* to Travellers along the Coast, I am well assured the *French* may very easily get good Information in regard to the Places of Advantage on the *British* Coast, where Troops may Land.

As reconnoiring Boats will be built so as to go faster than any Boat known in common Use, and having the Frigates to fly to in case of Pursuit, they may make bold with the Shore without Apprehension of Danger from any Pursuit the Enemy may make.

* Such Schemes are best contrived on the Spot, when Winds and Weather, &c. can be considered, yet written Schemes may introduce some useful Hints, and a General should know how to use Cunning as well as Courage. The Place pitched upon for the Feint should not be quite unconnected with a reasonable Scheme, if it is, the Enemy will discover it to be a Feint, and too easily guess the Truth.

three Lights, two of which hung at the Main Top gallant Mast Head, to be on in the Line directing to the Place where the Feint is proposed; the third Light to be hung low, advanced toward the real Landing Place, in a distinguishing Manner, so that the three Lights to a Person standing in a Line to, or at the real Landing Place, will appear in an equilateral Triangle; the Light advanced in its proper Place and hung low, will be a sufficient Direction to the Landing Place, and the Enemy on Shore will not readily understand it.

Every thing being ready for landing, the Boats designed for the Feint ought to put off from the Ships in Day Light, that the Enemy may perceive what Place they are designed for; and there ought to be no more Men in the Boats than what are sufficient to row them a head, and

More effectually to deceive the Enemy, I would have placed in the Boats a Number of Blocks with Hats on, that may appear like Men at a Distance; I do not mean that every Boat is to carry a Number of these Blocks, but only as many as may be sufficient to deceive the Enemy at a Distance, such as all the Boats in Front and Flank, with a few others distributed amongst the main Body, in the best Manner to cover the empty Boats.

When the Boats has continued their Course a proper Time, so that the Enemy may easily understand what Place they are intended for, a Signal may be made, as before must be concerted, to make the Men lie upon their Oars, as if waiting for Orders, &c. to spend Time that it may be something dark before the Boats approach near the Shore, to prevent the Enemy discovering the Deception.

If the Shallowness of the Water, near the Shore, will not admit of Frigates to lie near, to cover the Landing, or rather to make the Feint deceive the
Enemy

Enemy more effectually, the Vessels with the counter Bottoms (described in Chap. III.) ought to be sent before the Boats, and to take their Stations to compleat the Feint, so that the Boats may lie with their Ends to the Shore, in a Line between those Vessels.

The Boats having up their Defence (described in Chap. II.) may begin firing* upon the Enemy's Troops, if any appear; and if no Troops appear, I think it would not be amiss to expend a little Powder in firing after its quite Dark, to amuse the Enemy; for in such Cases every Party doth not exactly know where others may be drawn to and engaged in the Night, such sham Firing may mislead the Enemy, and perhaps draw their Forces and Attention that Way, and facilitate the real Landing†.

I hope to make it appear (in the Course of this Work) that it is very practicable to have such a Number of Vessels with Cannon to lie near the Shore, in any Place where Troops can land, that ten Thousand regular Troops on Shore shall not be able to hinder the Landing of the least Number of Troops.

Though the Landing a Number of Men in the Face of an Enemy that cannot beat them in the Field, can only answer the End of a Feint, or amuse an Enemy, yet the Advantage of being able to land any Number of Men at Discretion, notwithstanding a much greater Number of the Enemy

* As there is no Landing intended here, firing from the Boats can produce no bad Consequence.

† The Advantage of having Boats appears by being enabled thereby not only to send Divisions of Boats several Ways with Shams in such Numbers that the Enemy will not be able to know where the Landing is intended, but also to Land all the Troops together, who may gain Advantages while the Enemy in Parties are observing the several Divisions of Boats with Shams.

my is looking on, may, in many Cases, be of great Utility, for Instance,

Suppose it is determined to attack a very strong Sea-Port, whose Strength renders an Attack unsuspected, and Success depends wholly upon a Surprise, or sudden Assault, to surprize such a Place, let another Sea-Port be fix'd on to make a Feint upon, about twenty-five Miles Distance, * more or less, from the Place to be attacked.

Having both fix'd upon a Landing Place for the Feint, and the Plan of Execution, the Vessels with counter Bottoms and Cannon (described in Chap. III.) are to take their Stations near the Shore, that the Troops may land under their Cannon, and intrench before Night if necessary; this may be done with little, perhaps no Loss, as the Vessels with one hundred Cannon, if necessary, may lie so very near as to fight their Guns in five or six Feet Water.

Intrenchments being thrown up (See Plate II) before Night, and every thing done in order to secure the Troops, it is natural to believe that Expresses will be dispatch'd, and Forces put in motion, to succour the threatened Town: If the Wind is favourable, proceed as soon as dark to surprize the Place intended; if the Wind is not favourable, let the Troops remain, and next Day send more Troops ashore and proceed, that the Enemy may have no Suspicion it is a Feint (Care must be taken that none of the common Men, and very few Officers know what is intended

* Twenty or thirty Miles, or as far as Boats can row in a Night to surprize a Place before Morning, appears a proper Distance, as there is an Advantage in the greatness of the Distance, so that a Fleet of Boats can but run it to surprize the Place before Morning, having no Time to spare, for the greater the Distance, the less will the Place be alarmed, and a Surprise will the more easily succeed, and the greater the Distance, the longer will Troops be in marching from one Place to reinforce the other.

tended) thus a Day or two may be spent, in order to gain a fair Wind; but upon a powerful Enemy's Coast, too much Time must not be spent, lest they have Time to collect their Forces from far.

The second Night, as soon as it is dark, the Boats are to take off all the Men, and proceed to surprize the Place, if contrary Winds do not render it impracticable; for by this Time all their Troops designed will be sent from that Place to where the Feint is made, and will not only be without fear of an immediate Attack, but will have fewer Troops to defend it; and the Surprize is more likely to succeed; than if it had been attempted without making the Feint abovementioned, consequently affords a better Prospect of Success. * The Enemy seeing so many Vessels with Cannon lying so near to defend the Troops, will scarce venture to attack them, though greatly superior in Number, especially if those just landed are drawn up according to Plate II.

It is easy to conceive that a Nation which undertakes to distress an Enemy's Sea Coast ought to be Masters at Sea to do it securely and effectually.

C H A P.

* A Fleet having as many Boats as will either land or imbarck all their Troops at once, need not be much afraid of the sudden change of Wind, to raise the Sea, that they cannot re-imbarck their Men, especially in Summer; for in fine Weather it seldom happens that the Wind upon changing, from off Shore to blow out of the Sea upon the Shore, raises a considerable Sea in so small a Time, as Boats will require to row a Mile or two, to fetch Troops off the Shore.

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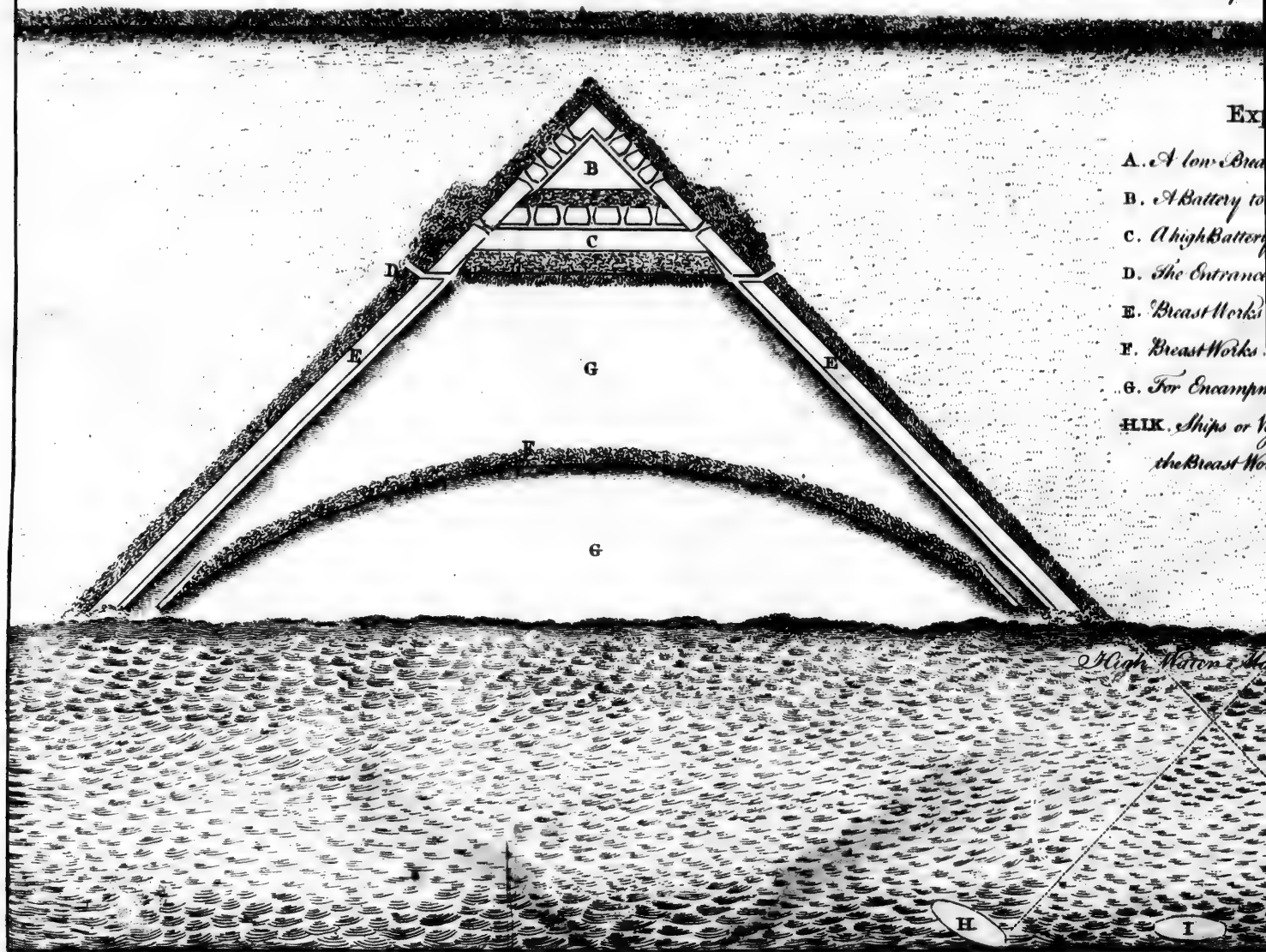
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Temporary works to secure a Retreat and where Troops



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- A. A low Breast
- B. A Battery to
- C. A high Battery
- D. The Entrance
- E. Breast Works
- F. Breast Works
- G. For Encampm
- H. I. K. Ships or Boats
- I. the Breast Wo

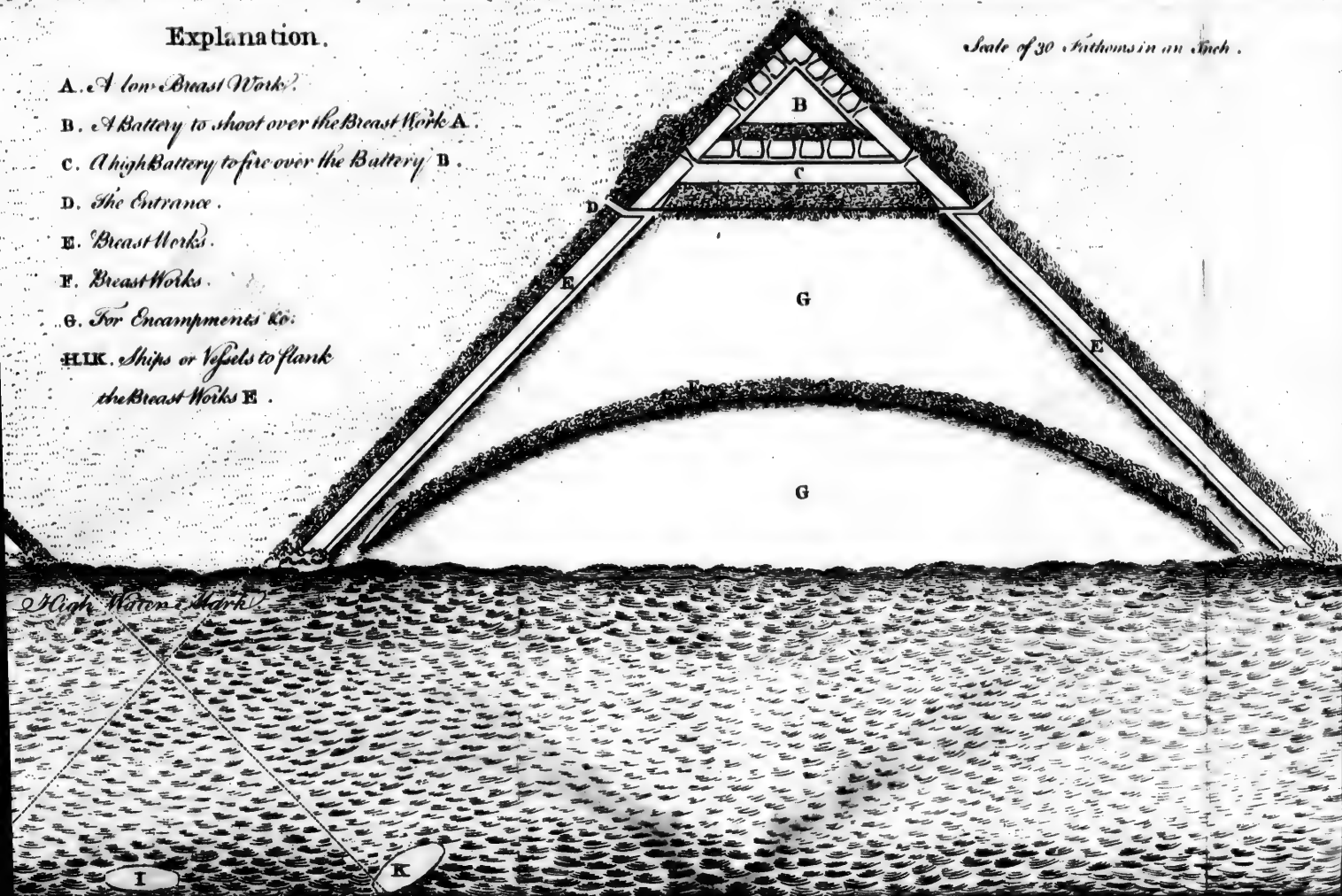
High Water

where Troops may defend themselves till they can be Embarked.

Explanation.

- A. A low Breast Work.
- B. A Battery to shoot over the Breast Work A.
- C. A high Battery to fire over the Battery B.
- D. The Entrance.
- E. Breast Works.
- F. Breast Works.
- G. For Encampments &c.
- H. I. K. Ships or Vessels to flank the Breast Works E.

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Of Real Attacks.

BEING arrived in some convenient Road, or Bay, &c. as near as possible to the Place to be attack'd, if it is thought practicable to take it by a simple Escalade, no Time must be lost in landing the Troops, and every necessary for that Purpose; but if that appear desperate and hopeless, the Place having taken the Alarm, then—

The utmost Endeavours must be used to land, as soon as possible, a great Number of light Cannon, and Mortars, with every Necessary, which may soon be done by the Help of rolling Breast-Works, † assisted with Boats, provided the Sea is tolerably smooth; the Troops may soon be landed, if Care is taken to have a sufficient Number of Boats to land them all at one Time; the Cannon, Mortars, and rolling Breast-Works § being landed, they may, without loss of Time (having a sufficient Number of Troops on Shore) be moved forward, and placed upon

† If the Shipping can deliver the rolling Breast-Works, Cannon, Mortars, &c. within a Mile and half of the Shore, one Hundred Cannon, mounted ready for Action, may be landed in about three Hours Time, after the Ships are brought up. See the first Pages of Chap. V.

§ The Rolls that are designed to resist Cannon Balls, must be put into Water as soon as may be, to imbibe sufficient to make them heavy, and not to be burned by the Enemy: If the Rolls are work'd hard and close, they will take above twelve Hours to get sufficiently full of Water; but in a sudden Attack wetting the Rolls may not be practicable, for want of Time, or a convenient Spot of Water.

upon the Glacis, † within twenty or thirty Yards, or Feet of the Palisades in the Covert-Way, as will appear more evident in the two or three following Pages.

Having every Necessary on Shore, answerable to the Cannon and Mortars, with their rolling Parapets, that can be properly planted in the Distance between the Points of the two Ravelins on the right and left of the Front, design'd to be attacked.

As the Barb Batteries will do most Mischief in an Attack of this kind, a sufficient Number of proper Cannon and Musqueteers, covered by rolling Parapets, must be employed to beat the Enemy from their Guns, or dismount them; and if all the Cannon that may be brought by the *British* Navy, against a Place situated near the Sea, are well served, assisted by the Musquetry, and well covered by rolling Parapets, they will be able to maintain such a great and constant Fire, that few of the Garrison's Troops will venture to shew their Heads above the Parapets to oppose the Escalade. But

If it is known that the Ditch of the Place is broad and deep, and full of Water, * and has a Revetiment, a strong Garrison well provided with large Batteries of Cannon in the Flanks, and every Thing proper

† When the Rolls are got to the Place assign'd, set Struts to hold them, that they may better resist the Balls, till they can be sufficiently staked and earthed, by driving Stakes into the Ground prepared and shod with Iron for that Purpose, and throwing Earth over them as fast as possible, to make a stronger Defence; but in a Surprise, or sudden Attack, the Rolls can perhaps only be staked. *N. B.* By Means of rolling Breast Works, the covered Way of the strongest Place may soon be taken.

* In surprising Places in Summer, whose Ditches are full of Water, every Man that is to cross it should have a broad Belt round his Body, close under his Arm-pits, with part before and part behind, (so large as not to hinder the Use of his Arms) to

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proper for a good Defence. The Barb Batteries, and the Guns in the Flanks of one or two Fronts at least must be silenced, before an Escalade is attempted; but, perhaps before the Guns in the Flanks can be silenced, the Ravelin, or other Works before the Curtain must be taken, which probably may soon be effected, by Means of the great Number of Cannon, Mortars, and rolling Breast-Works, in the following Manner.

Every Necessary being landed, and accompanied by at least three Times the Number of Troops that are in the Garrison, and as many Sailors as can be spared from the Fleet to assist in rolling the Breast-Works, &c. to the Place, advance in the Night (undiscovered if possible) with so many light Cannon as can be planted in a proper Manner against the whole Length of the Fronts to be attacked, and a good Number of Mortars, with a great Number of rolling Breast-Works to be rolled in the Night as near the Defences of the Place as can be done safely, without being discovered; at the same Time a sufficient Number of Cannon, of eighteen or twenty-four Pound Shot ought to be brought forward, covered with rolling Breast-Works of about seven Feet diameter, to silence the Barb Batteries.

When it is near Morning move toward the Place in the following Order;

The Cannon, that are appointed to dismount the Cannon on the Barb Batteries, ought to move on first, covered by rolling Breast Works, in order to be

blow full of Wind upon Occasion, to prevent his Body from sinking too low in the Water; when the Men are landed, the Wind is soon let out, and the Belt but small Incumbrance; such Belts may be of great Service to Armies in crossing Rivers, &c. a Place upon, or near the Sea Coast, without a Revetiment, may easily be taken by Surprise. Something like Fins may be fastened to the small Part of the Legs, by which Means Men may go faster thro' the Water.

be ready to fire upon the Barb Batteries as soon as it is Light,

In the second Place move forward with two Lines of Rolls, the first Line in close Order, the second Line in open Order, leaving about two Feet Opening between every Roll; these Lines extending the whole Length of the Fronts to be attacked, and also to extend to the Ravelins Points, or middle of the next Curtains; on the right and left of the Attack, to cover the Attack from the Fire of the Flanks and Ravelins on the right and left, at the Ends of the Lines of Rolls, for the Fire from the Ravelins and Flank, will in some Degree flank the Troops on the right and left of the Attack, behind the first Line of Rolls, place three Ranks of Musqueteers, one Rank to relieve another alternately, in rolling the Rolls forward, and two Ranks to stand under cover of the Rolls, ready to fire upon any of the Garrison that appears to obstruct the Design; proceed with these Rolls within about twenty or thirty Feet of the covered Way, where stake and Earth them well, especially where the Guns in the Flanks, &c. can play upon them. The Guns in the Barb Batteries perhaps are by this Time near silenced; the Soldiers behind these Rolls are to continue to throw Grenades, Stones, &c. into the covered Way and Places of Arms, till the Soldiers there are driven out.

The light Guns, appointed to plow the Tops of the Parapets, &c. to prevent the Musquetry in the Place from firing briskly upon the Troops, are to move forward under the Cover of the second Line of Rolls, (keeping a convenient Distance behind the first Line of Rolls) when both the Lines of Rolls are advanced to their proper Stations, and the front Line well staked and earthed, alter the Position of every Roll in the second Line, by hawling

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ing about their Ends to an oblique Direction, so that the Guns may have Room to be drawn through between them, to be placed under the first Line of Rolls, where they are to perform their Service upon high and broad Wheel Carriages, that require no other Platform but the Ground; previous to this, every Roll in the Front ought to be fitted with a Piece to take off from each End, in order to make Embrasures, and those Pieces are to fill up the Openings between the Rolls in the second Line, behind which the Musqueteers* are to be placed after the Cannon is moved to the front Line†. These two Lines being compleated, and the Guns and Mortars ready to fire upon the Place, proceed to roll Rolls over the front Line, into the Covert Way, over against the saliant Angles of the Tenaillons, Ravelins, &c. and when there is a sufficient Number of Rolls rolled over into the Covert Way, Men may go amongst them and put them in Order; for in the mean Time, the Guns, Mortars, and Musqueteers, behind the Lines of Rolls, will be able to maintain so constant and so great a Fire, and the Troops throw so many destructive Things into the covert Way, that very few will venture to show themselves to fire from the Place, or approach along the covert Way, in order to obstruct the Proceedings.

When there are a great Number of Rolls rolled over, and a Passage made over the Ditch to the Ravelins, Tenaillons, &c. a great Number of

D

Mortars

* The Musqueteers to be tall Men, and Cannoneers short Men.

† If a Number of Cannon were mounted upon Carriages with Wheels seven or eight Feet high, to form a rear Line of heavy Cannon and Mortars to fire over the light Cannon, Mortars, and Musqueteers in the front Lines, it would greatly awe the Town, and contribute much toward a speedy Surrender.

If Cannon were mounted eight Feet high, the Carriage may be so constructed that the Gun could be loaded and fired to good Purpose.

Mortars must continue to throw Stones, Shells, &c. into the Tenaillons, Ravelins, &c. while Miners are sent to make a Mine or Mines, to blow up the Ramparts, or Pioneers to dig a Passage, throwing the Rubbish into the Ditch; perhaps both Miners and Diggers may be employed at the same Time to good Purpose, in order to make a Passage to roll Rolls into the Ravelin, both to cover the Men and to make Batteries expeditiously, to silence the Guns in the Flanks, &c. being assisted by a great Number of Mortars placed opposite every Flank, in order to throw Shells, Stones, &c. into the Flanks and other Places. See Plate III.

While the Works before the Curtains are carrying on, and the Flanks silencing, collect great Numbers of Rolls before the Curtains, and also opposite to the Faces of every Bastion, in order to cross the Ditch in three Places, on every Front attacked, (*i. e.*) a Passage is to be made before every Curtain and Bastion Face that is designed to be assaulted; when the Rolls that are to be rolled into the Water in the Ditch are at the Edge of the Water, fasten a Bag of Earth to each End before you roll them in, otherwise they will swim very buoyant at first, if they have not before been laid in Water twelve or fourteen Hours to soak; when the Rolls appears above Water, and every Passage compleated, send over each Passage a Number of Men, with Iron Claws fixed to their Feet and Arms, to enable them to climb better in order to receive the Ends of Ropes or other Ladders, (from other Men sent over with them) and fasten them, that Men in Arms may mount the Rampier, or Pioneers may be sent over the Ditch, to make three or four Places like Steps, horizontally along the slope of the Rampire, that two, three, or four Ranks of Grenadiers may stand easily, and prepare to mount the Rampire while Troops are crossing

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the Ditch, and ranging themselves along the Berm or Faufs Bray, if any be, in order to sustain them.

When the Troops are crossing the Ditch, and placing themselves behind the Rampire, &c. the Cannon must be made to graze on the Top of the Parapets, and the Mortars on the right and left keep a brisk Ricochet Firing into the opposite Bastions; the Cannon and Mortars being properly placed to fire a Ricochet along the Inside of the Parapets of the Curtains and Bastions Faces that fronts the Attack, so that few Troops of the Garrison will be able to stand upon the Rampire to oppose the Assault.

If the Situation of the Town is such that it can be attacked by Sea and Land at the same Time, and that one of the Attacks by Land can be made near the Sea, where Vessels can come to assist, such an Attack will in all Probability succeed sooner and better. Or

If the Situation is such that three or four Sides can be attacked at once, with a Force against every Side equal to that before mentioned, the Place will be more easily mastered. I imagine it cannot be denied but a maritime Power, which is Master at Sea, and can send a sufficient Number of Troops to master for ten or twelve Days, six or eight Days may perhaps answer the End, (as every thing may be landed at the most convenient Landing by means of the floating Batteries described in Chap. V.) a Part of the Enemy's Country near the Sea, may come so very unexpectedly against a Place in the prime of Summer, and land so great a Force of Cannon and Mortars, and every Necessary before mentioned, for taking a strong Sea-Port, that Success in destroying the Town, Harbour, and Shipping, may with Reason be depended on.

If there are Counter Guards before the Bastions, the Place must be taken at the Curtains, while a great Number of Mortars are employed in throw-

ing into the Bastions, especially into the Flanks, Shells, Stones, Grenadoes, and every other destroying Engine that can be invented, to hinder the Garrison from making their Defence; the Front attacked * must at the same Time be furiously enfiladed.

In the next Place let it be considered what a well provided Town can do against the Attack before-mentioned: They will have little Time to raise Palisadoes, or make Retrenchments, and their Cannon and Mortars will do them but little Service against so great a Number without, and the Attack will be sudden, by Reason of the sudden Approach of a Fleet, and the rolling Breast-Works not only rendering the Covert-Way almost useless to the Place, in so very little Time; but also in a great Measure prevent the Sallies; and the Mines, the only Danger to be feared, will hardly be got loaded and fitted ready to spring in the Surprize and little Time the Place will have to make its Defence; Supposing

* As the Ricochet Batteries must be nearly perpendicular to a Line, to enfilade it properly, it may, therefore, be proper to shew how the Line of a Curtain may be found without the Place.

The Curtain may always be supposed parallel to the exterior Side of the Polygon, therefore find the Line of the Bastions Points, which is very easily done by bringing the Bastions Points in a Line, if the Works before the Curtain do not hinder the Sight, and then consult how many Feet or Yards the Recess of the Curtain is, and erect a Pole, at least Musket Shot from the Place, of a sufficient Length as near the Line of the Curtain as you can guess, and hoist a proper Man up to its Top, with a Glass if its a good Distance; the Man at the Top of the Pole will discover something nearer where the Curtain Line falls. Erect another Pole and hoist an Engineer up to its Top; by this Manner of proceeding to place three or four Poles, the Line of the Curtain will be found exactly. There are other Methods to find the Line of a Curtain without the Place, but that above being as easy and certain as any, I omit the others.

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Supposing it as well prepared as Towns generally are that apprehend no sudden Attack. If the Towns attacked in the Manner here described do not hold out after the Danger is become greater than the Danger Places were generally in that have lately surrendered, there will be no Occasion of lodging Troops on the Slope of the Rampire, &c. to storm the Town: For

It is not improbable but the Place will surrender soon after the Cannon and Mortars begin to fire from behind the Lines of Rolls, as the Troops of the besieged will be at first driven out of the Covert-Way, and Places of Arms, by the Troops behind the Lines of Rolls, they having so much the Advantage of the besieged, by being secured upon the Ridge of the Glacis, and can throw Shells, Stones, and every other destroying Engine, under ten or twelve Pound weight, into the Covert-Way and Places of Arms, the Besieged cannot reach the Besiegers in the same Manner, they having to throw upward, by which Advantages the Covert-Way, in all probability, will be taken in the first twenty-four Hours, and the Surrender of the Town will soon follow.

If the Place have a dry Ditch that cannot be filled with Water, proceed in the Manner already described, and take the Covered-Way, and throw Shells, Grenades, Stones, and every Thing that will best drive the Garrison out of the Flanks and Works before the Curtains, and being prepared with light Rope Ladders, that have Chains of a proper Length fix'd to them, with Balls at the other Ends to be put into Cannon, in order to be shot across the Ditch into the Rampier, to hold the upper Ends of the Ladders fast, leaving the after End hanging down the Revetiment, so that the Troops may go hastily across the Ditch and mount

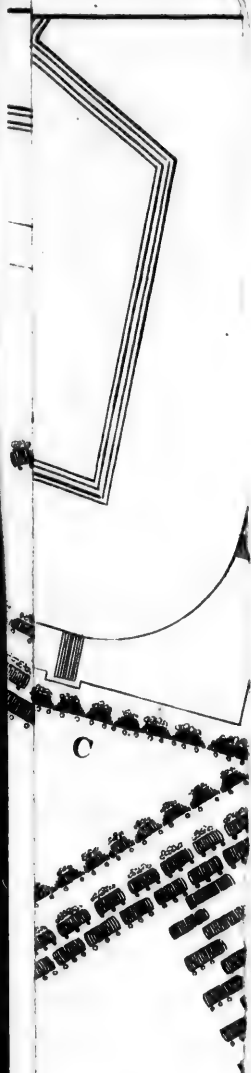
the Ladders * without being obliged to stop to fix them, by which Delay many are generally killed.

If the Place has a second Covert-Way, this Covert-Way must be taken in the Manner already described, and the Ditch may soon be made passable with little Loss, by Means of the rolling Parapets; but if a Ditch is to be crossed before the Fire of the Place is silenced, advance to the Ditch with a sufficient Number of rolling Parapets in front, stake and earth them, close at the Edge of the Ditch, in order to keep off the Enemy's Shot, and lay stiff Planks, with one End upon the Rolls that is staked and earthed, to roll other Rolls up upon, in order to roll them over the front Rolls that are staked and earthed, so that they may roll into the Ditch to fill it up: If it is not thought proper to take Time to make a Passage over it with Earth, the Side next you will be first full of Rolls, upon which begin to throw Earth over the rolling Parapets, that lie for a Defence, till you have thrown over a Quantity sufficient to make a Plain, to advance your rolling Parapets upon, in order to roll over more Rolls, to fill more of the Ditch; keep the first Rolls where they were fixed at first, and roll other Rolls over them to an advanced Defence, over which roll more Rolls to fill up the other Part of the Foss, which being sufficiently full of Rolls, if a great Fire is made from the Town, throw Earth over the first fixed Rolls, then over the advanced Rolls, from Hand to Hand, and so continue five or six Casts, or more, if Need be, from Hand to Hand, over the advanced Rolls, till the Ditch is sufficiently filled up for a Passage over. Thus

* This Manner of fixing Ladders has not been tryed that know of, but if it carry the same Face to Engineers, who are practiced in those Arts, as it doth to me, it is worth showing an Experiment upon.

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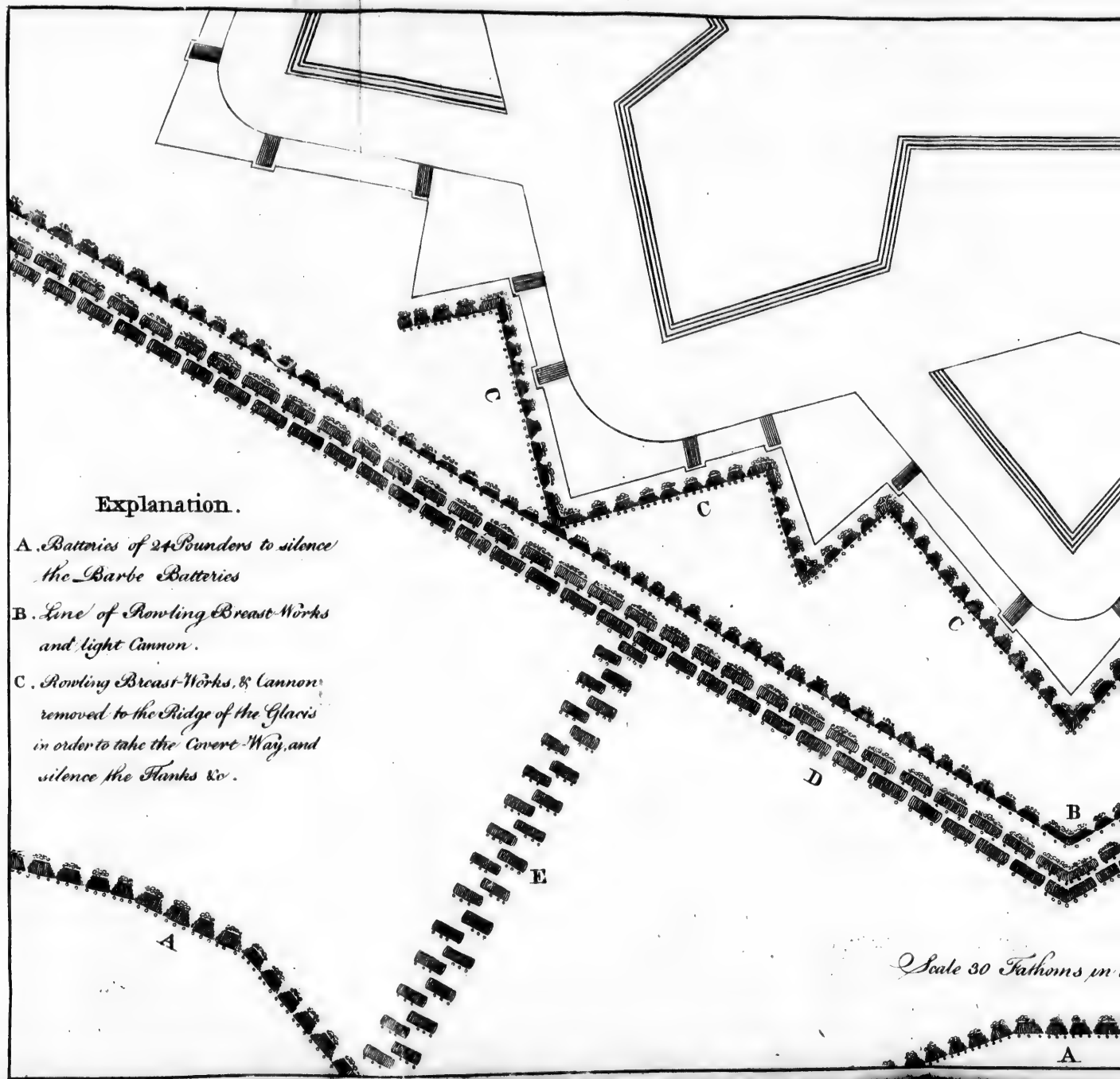
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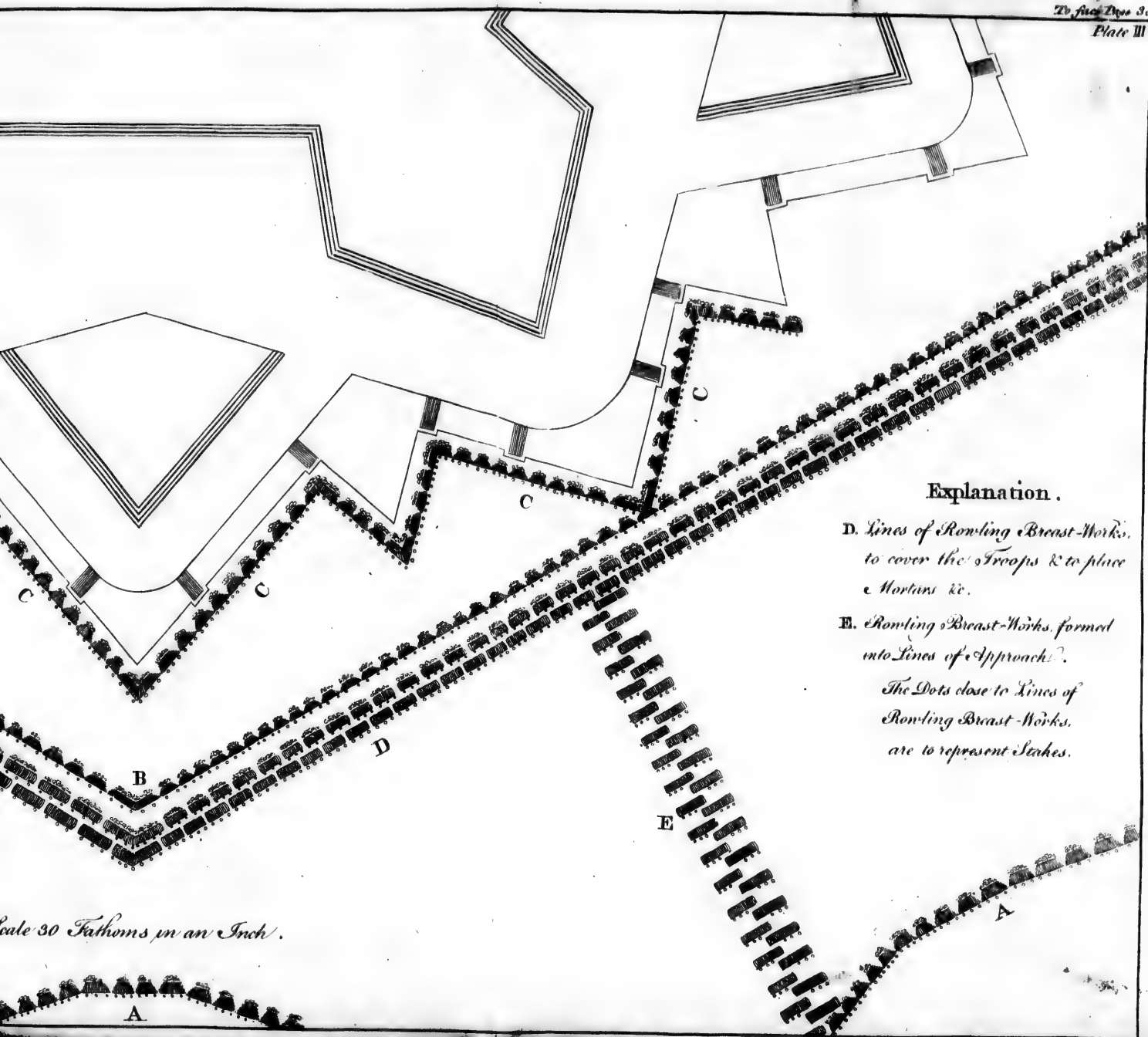


Explanation.

- A. Batteries of 24 Pounders to silence
the Barbe Batteries
- B. Line of Rowling Breast-Works
and light Cannon.
- C. Rowling Breast-Works, & Cannon
removed to the Ridge of the Glacis
in order to take the Covert-Way, and
silence the Flanks &c.

Scale 30 Fathoms per





Explanation.

D. Lines of Rowling Breast-Works,
to cover the Troops & to place
Mortars &c.

E. Rowling Breast-Works, formed
into Lines of Approach.

The Dots close to Lines of
Rowling Breast-Works,
are to represent Stakes.

Scale 30 Fathoms in an Inch.

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Thus may as many Passages be made at the same Time as is necessary; but if the Bridges (described in Chap. VII.) prove manageable, the Use of such Bridges will be much the quicker Way to cross Ditches.

It will easily be perceived that the foregoing Methods of attacking Places of Strength, require a great Number of Rolls of so great a Size as cannot be conveniently carried by Land, and the moving Bridges will be very cumbersome to hawl to any considerable Distance by land, not to mention the great Number of Cannon and Mortars proposed in this Manner of attacking Places; all which renders it scarce practicable for an Army by land to attack Places in this Manner.

Nor will it be prudent, or adviseable, for any Power that is liable to be attacked on the Sea by a superior Force to attempt these Methods, except in some distant Part, for the great Number of Cannon and Mortars to be employed on Shore, and the Bridges, rolling Parapets, &c. will take up a considerable Time to imbark them, notwithstanding the Troops can imbark in a very little Time, and thereby give a superior Power more Time to arrive, and the Risque of losing such a Number of Shipping as must always be employed in such Enterprizes, and so many Cannon, Mortars and other Materials on Shore, &c. will be greater than the Prospect of Advantage; especially when it is considered that the stronger Power at Sea can, by the foregoing Methods, take the Place again in five or six Days.

It doth not require great Penetration to perceive the vast Advantage *Britain* has over all other Nations by being Masters at Sea: I shall only give an Instance in this one Case; let it be supposed the *French*, or any other Nation, should attempt the Methods here described, would not they run a great

Risque

Risque, and always be afraid of being surprized by our stronger Squadrons? can they lie upon the Sea secure and pursue their Operations as the *Britains* can? or can they, when they attack a Place belonging to *Britain* with Ships, promise themselves, with any Degree of certainty, that they will not lose their Ships and Troops, and every Thing they bring before the Place?

C H A P. IX.

Of fitting old Ships of War in a different Form after they have been condemned as unfit for Service in the common Way.

AS such Ships are esteemed but of small Value when condemned, the only Way to make them useful afterwards, will be to fit them up with smaller Masts and Rigging, and to contrive them so within that they cannot sink, and by altering their Guns to a different Position, enable the Ships to carry them with greater Ease and Safety, and make the Ships much more formidable to batter Forts and Castles, which may be done by various Methods, of which take the following Example.

Bring on two or three very thick binding Strokes on the Outside, about the Floor Heads, fore and aft, and secure them well, which will strengthen the Bottom much; and if it should so happen that the Ship should come on Ground, will also keep her more upright and prevent Damage by her over heeling; then bring on two or three Strokes more of Clagging, to round the Bulge fair; in the next Place proceed to fix several Rows of strong Eye-Bolts, fore and aft, through the Keelsen and Keel, and through the binding Strokes on each Bulge, well clunk through Iron Plates, let in juſt their
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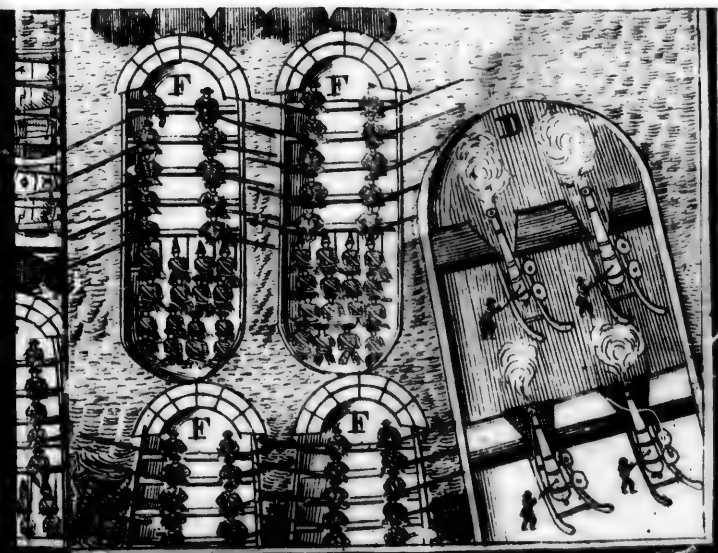


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Risque, and always be afraid of being surprized by our stronger Squadrons? can they lie upon the Sea secure and pursue their Operations as the *Britains* can? or can they, when they attack a Place belonging to *Britain* with Ships, promise themselves, with any Degree of certainty, that they will not lose their Ships and Troops, and every Thing they bring before the Place?

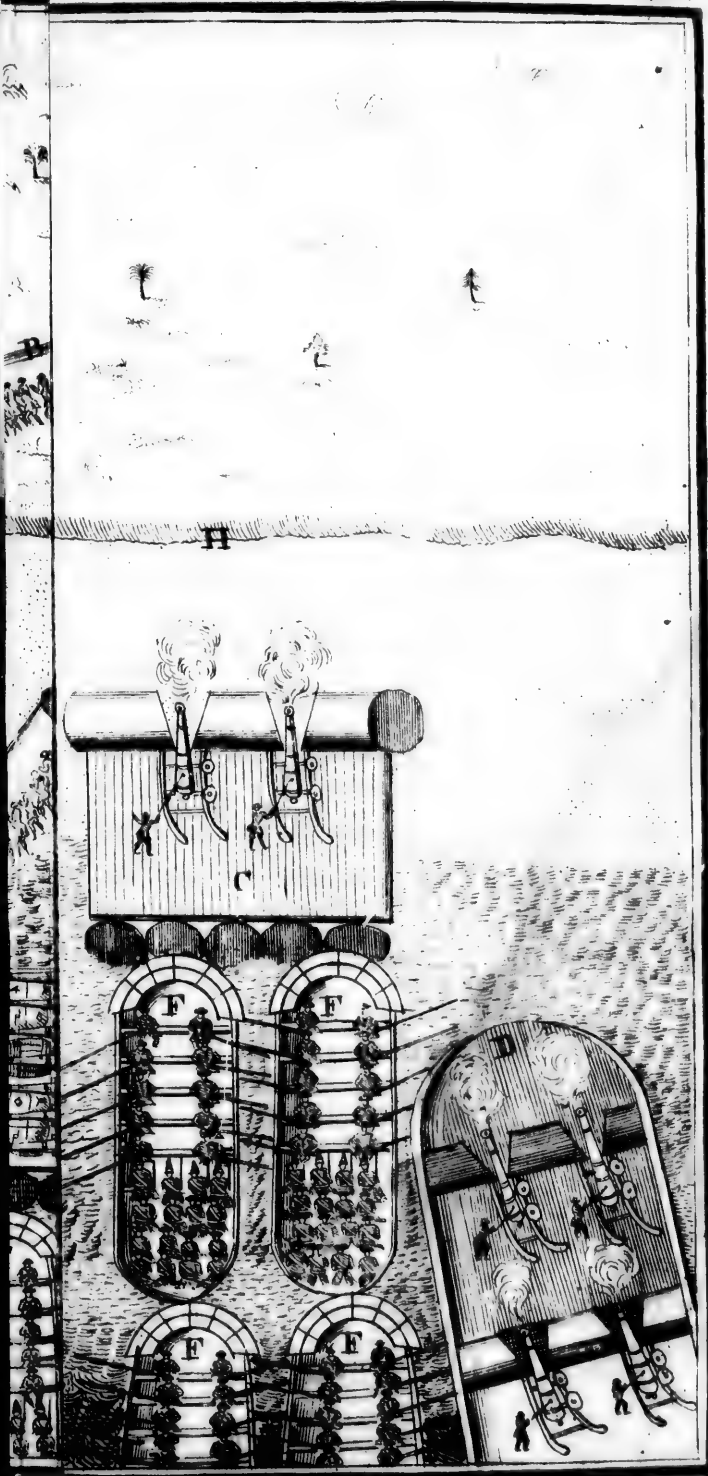
C H A P. IX.

Of fitting old Ships of War in a different Form

E X P L A N A T I O N. Plate 4. [To face Page 40]

- A. Rolling Parapets fix'd on Shore, for a Battery of 4 Cannon.
- B. Men rolling Parapets ashore to enlarge the Battery already made, or to make other Batteries further on the Land.
- C. Floating Batteries, or rolling Parapets, which may be taken asunder and placed on the Land, as A. B. or otherwise.
- D. Flat-Bottom'd Vessels to protect the Landing.
- E. Stores upon Floats of rolling Parapets.
- F. Boats full of Men to be landed in the Face of the Enemy.

on two or three very thick binding strokes on the Outside, about the Floor Heads, fore and aft, and secure them well, which will strengthen the Bottom much; and if it should so happen that the Ship should come on Ground, will also keep her more upright and prevent Damage by her over heeling; then bring on two or three Strokes more of Clagging, to round the Bulge fair; in the next Place proceed to fix several Rows of strong Eye-Bolts, fore and aft, through the Keelsen and Keel, and through the binding Strokes on each Bulge, well clunk through Iron Plates, let in just their Thickness



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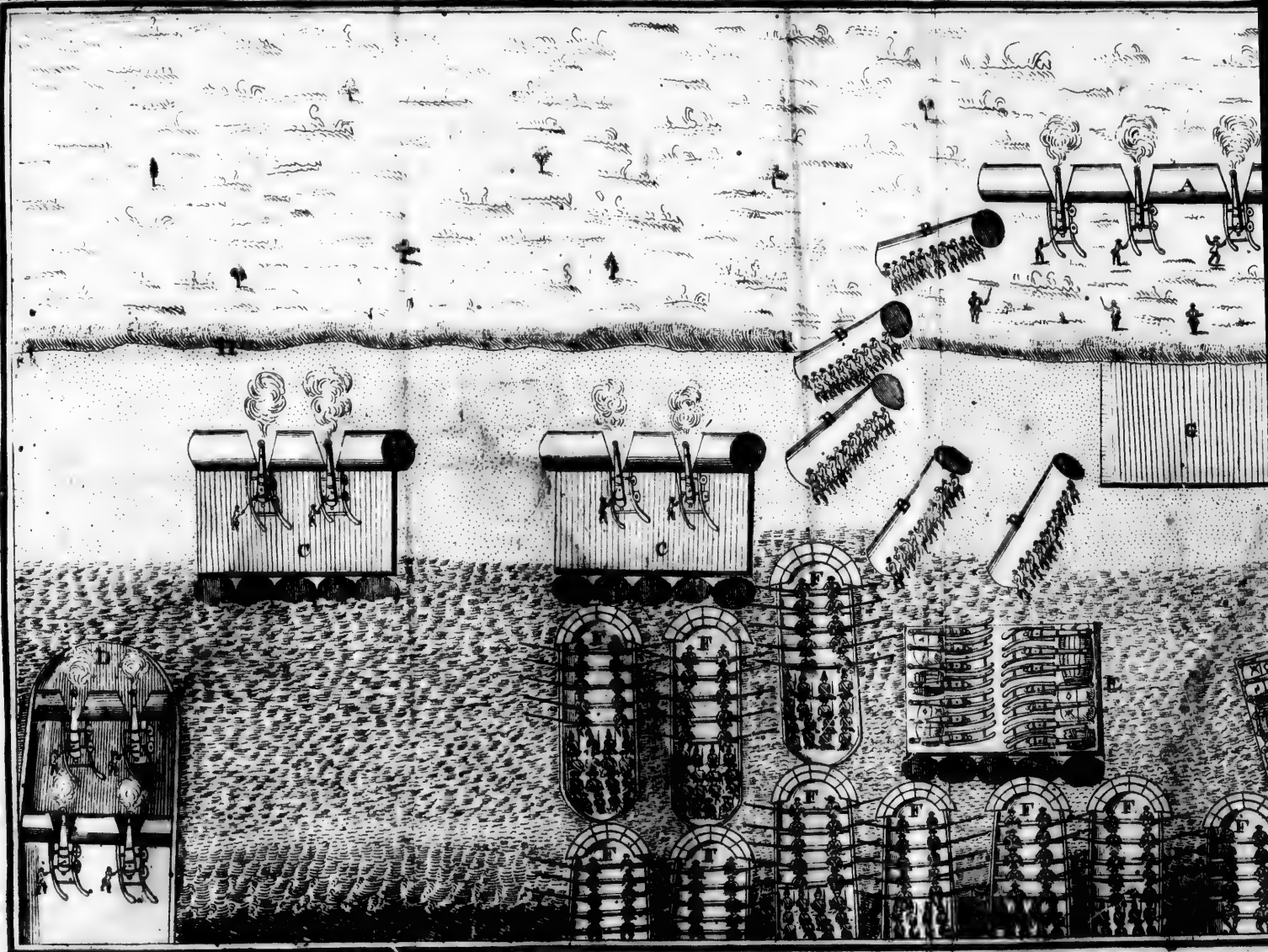
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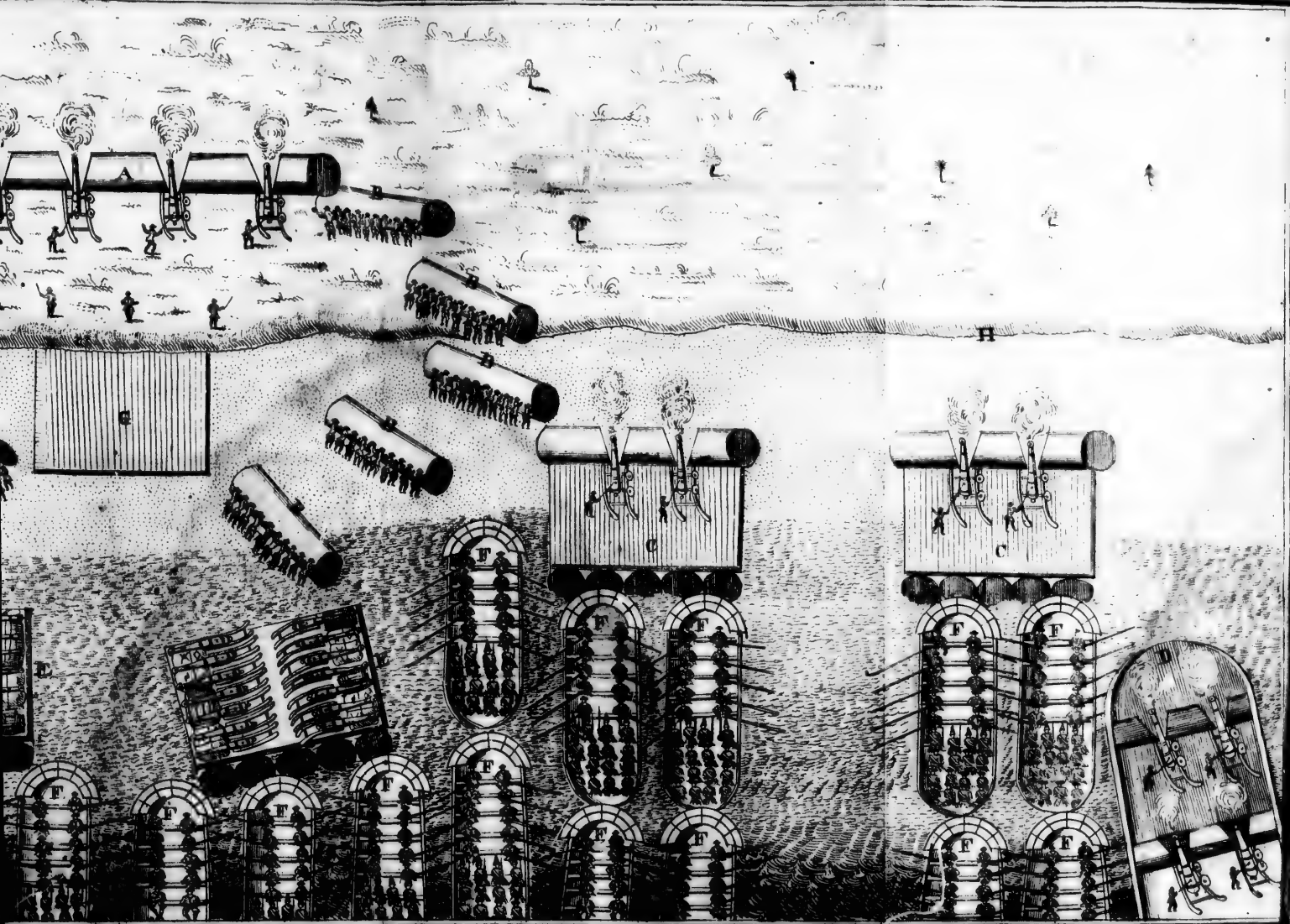
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Thickness into the outside of the binding Strokes ; and there must be as many of these Eye-Bolt as will be thought sufficient to bear the Weight the Ship will swim at ; to each of these Eye-Bolts fix three strong Chains of different Lengths, in Proportion to the Depth of the Ship, and to the Thickness of the Stratum of Materials that are to be put in to swim her by ; after which hang these Chains perpendicularly up, and stop them tight fast ; then clear the Hold, take out the Pumps, and afterwards take in as much clear worked Shingle for Ballast, with some Chalk Rubbish to make it bed solid, to keep out as much Water as possible, and as will be sufficient to ballast her, respect being had to the Weight of Rigging, Guns, &c. that is to be above Water, after the Ballast is in, which is to be laid fore and aft close down to the Cieling, in such a Manner as will answer her Trim for sailing, when she has Ballast sufficient for Sea ; make the Ballast very smooth and level, then cover it all over with good Fir Planks laid across, that will join close to each Side of the Chains, that must be fixed in exact Rows across the Ship, to which they may be secured, or kept down, by running strong fore Locks, &c. through the Links of the Chains ; next proceed to lay a Stratum of Cork, or some other light Materials, about six Feet high, so close packed together as to leave as little Vacuity as possible ; make the Cork plain at Top, and lay Balks of light Timber, fore and aft upon it, close to each other, taking Care that the Ends of these Balks always butt in a Line with the Chains, for the better Opportunity of the several cross Balks that are to come upon these fore and aft Balks, one on each Side the Chains, by which they are to be fastned down ; which done, lay great Weights upon the Bed of Timber, as Cannon, &c. or force of Screws, and after stand-
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ing to settle some Time, the Whole may be fastened down together, by the first and shortest Chains.

The first Bed or Stratum of Cork and Timber being thus secured, proceed in the same Manner to fix a second or third, fastened well down with their separate Chains, taking particular Care that the Butts of the fore and aft Pieces be well shifted, and the cross Pieces be sufficiently secured, and every Tier of Balks made as tight as the Business will admit of, to prevent the Water swelling too much in the Ship when it may happen to be let into her.

If the Cork lie in the Ships long, and thick muddy Water is often let in among it, in process of Time the Cork will grow too heavy, therefore it may be proper to stow in the middle of the Ship fore and aft, upon the first Stratum of Corks, one Breadth of hollow Bodies, made like Casks, but very strong; these hollow Bodies may be proper to assist the Cork in swimming the Ship, and Experience will shew what is best; and should it prove that the Hold will be mostly taken up with the Courses or Stratums of Cork, so that there will be little Room left for the Stowage of Provisions, &c. a Vacuity or Room in the Midships may be made fore and aft, in the last or upper Course, or Stratum of fourteen or sixteen Feet wide, water tight for that Purpose, and the Space between which and the Ship's Sides may be filled with Cork as near as possible to the Water Line, that the Ship will swim at when her lower Tier of Guns, which are all intended in these Ships, Stores, Provisions, &c. are all on board, and a tight Deck laid over all, and the inside Cieling for three or four Feet above the tight Deck made also tight, to prevent the Water

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spanging up when the Ship heels by carrying sail, rolling, or otherwise*.

As such Ships are designed to lie before Forts and Batteries, which will be more fully described by and by, the next Care will be to contrive Defences for the Men on board them, which may be done in the following Manner, *viz.* contract the Breadth of every Gun Port nearly to the Diameter of the Gun, for as these Ships are chiefly designed to lie before Batteries, in such Manner as to stop the Battery's Fire from other Ships passing on their off Sides, there will be little Occasion for the Guns being laid in an oblique Direction. When got near the Place of Action, fix upon the Ship's Outside, between every Gun Port, Quilts made of any cheap Matter that will not readily take fire, and will deaden a Ball much; I cannot at present think of a better Material for this Purpose than the feathery Part of Quills, cut as long as may be, not to spoil the Quilt†, and Woollen as mentioned in Chap. V. which being wetted will hardly take fire; the Thickness of these Quilts to be such that two or three Thicknesses of them be as thick upon the Ship as to fill her Side out so far as the Muzzles of the Guns reach, when run out in order to be fired: Their Meetings must not be opposite each other, so that a Ball hitting upon the Joint on the outside may

* As such Ships will be lightly rigged, and need no more Men on board than will be able to navigate them, it is presumed that by the Help of such a Room and other Contrivances, six Weeks or two Months Provisions may be stowed at once, and as they are only designed to go along with Fleets upon some Enterprize, they may be at every Opportunity replenished from the Fleet.

† The Tops of all sorts of Quills are very strong; if a Quilt were well made of them it would be very strong; this Material may be had cheap, it being generally thrown away as not fit for any Service.

may find a Joint straight forward ; the Length of these Quilts about seven Feet, the Breadth equal to any Measure that three, four, or five, &c. will exactly fill each Space between the Guns, as likewise below and above every Gun ; and between every Gun on the inside, place a Number of thinner Quilts, one behind another, the Length of every one of these Quilts to reach nearly from Gun to Gun, and the Breadth nearly the Height between Decks ; let them be fastened loosely together at Bottom and Top, that every outermost single Quilt may have Liberty to be pushed back, but the Sides made as strong together as the Quilts are in other Parts ; at every Corner of the united Quilts make a strong Noose to fasten strong Ropes that are to hold the Quilts near the Ship side, by having a sufficient Weight hung at each Rope's End below the Gun Deck, so as to hawl up or let down at leasure, and yield to any great Force, so that a Ball coming through the Ship's side, with the Splinters, may be caught in these Quilts, and if not confined there, may not do much Mischief after. How this may appear to the understanding Reader, I know not, but as the Force of Cannon Balls are resistable, their Force may be stopped, and when a Ball has forced its Way through the Quilts on the outside, and through the Ship's Side, its Force must be greatly lessened when it meets the inside Quilt, which yields to its Force, and stops it in a gradual Manner.

Between the other Decks (for the higher these Ships are out of the Water, the better Muzzle or Defence they will afford to the Ships they are intended to cover) fix two Rows of strong Stantions, fore and aft, fifteen or sixteen Feet apart, and fill the Space between them and the Ship's Sides with any cheap Stuff that will deaden the Force of a Ball, and

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not easily take fire; such as Bags of Hogs Hair, coarse hairy woollen Raggs, &c. which must all be wetted in time of action, for the better preventing of fire; and the upper Deck may likewise be made a safe Place for Men, by being fitted in the Manner last described.

A Ship thus fitted, will not only cover her Men extremely well in time of action, but has also this great Advantage, that, let never so many Shot go into her Bottom she cannot sink; nor need the Bottoms of such Ships be caulked, it being evident they will swim* at all times alike, by the Materials put into them, and the Ballast in their Bottoms will make them stiff enough; however, to make the Ship more lively, and sail the better with a Fleet, I would recommend the Bottom to be kept tight as long as it can; and the more so as it will have the great Advantage of being more wholesome for the People.

CHAP.

* If any Diffidence should arise, in regard to the Ship's swimming, (when fitted as here described) a Proof may be made by taking any small Vessel, fitted with Masts, &c. and fit her up in the same Manner as here described; after which let the Water in, and try how low it will sink her; then put in as much Weight in proportion to her, as the Guns will be in Proportion to the Men of War so fitted; then try what sail she will carry, and I make no doubt (if the Ballast be well proportioned at first) but she will be as stiff to carry sail, as Ships generally are; and it would be necessary such like Experiment be made, to find out a just Proportion of Ballast to be put at first into the Ship's Hold; and would not be amiss, if two or more Wells were contrived, from the gun Deck, to the Bottom of the Ship, to put in, or take out, more Ballast at pleasure.

C H A P. X.

As the last Chapter hath treated on the making old Ships of War proper Ships to lie Broadside on, to muzzle Forts or flanking Batteries, and cover the other Ships that pass them, so this will treat of such like old Ships of War, fitted up in a different Manner, to lye End on, and to batter Castles, Forts and Batteries, in the following Manner, viz.

IN Place of carrying two or three Tiers of Guns at their Sides, they are now to carry four or five Guns in a Tier, athwart Ships, according to the Size and Breadth of the Ship that is to be so prepared; first Rates may carry eight, second Rates seven, and third and fourth Rates six of these Batteries, one above another, beginning the first Battery platform, close forward upon the lower gun-Deck; though perhaps it may be found necessary to lower the fore Battery, two or three Feet below the lower gun Deck; the Foot of the next Parapet ten Feet* farther back, towards the Ship's Stern, and about five Feet higher than the first, and so on till the Length and Height of the Ship above Water, are filled up with succeeding Batteries, Here an Objection will immediately arise, How will the lower fore Batteries be able to fire, on account of the Ship's Bows, which must be in the Way of the Guns? To which it is answered, the Ships

* Though ten Feet is only allowed between the Parapet for Men to stand and load the Guns, the Guns will have sufficient room to run under the Parapet next behind them, there being designed four Feet and a half in height, clear, between each Platform, and the under Side of the Beams that supports the Parapet and Platform next behind it.

Ships, for this use, may be so fixed, that when they arrive near the Place of action, their Bows and Fore-parts may be taken down sufficiently low, and it will be necessary the Fore-mast and Bow's-sprit be taken out, if the Ship can be brought to her Station without them; which may be re-placed at pleasure after the Action.

The next Thing to be contrived is a Defence for the Men, by having Parapets of about eight or ten Feet bale, and six Feet high, before every Battery of Guns, and as the Top of each preceeding Parapet will cover two Feet at least of the Foot of the next succeeding Parapet, few of the Enemies Balls can get under the Platforms to do mischief there, and the Batteries cannot be enfiladed, as the Ship's Sides are not to lie to the Enemy; and the Parapet inclining aftward, so as to make the Angle at the Base about thirty Degrees, will give so great a Slope to the Parapet, that the Enemy's Balls (except shot from a very high Battery) will fall upon it with a small Angle of incidence, and will consequently fly upward, without doing much Damage, especially if the Slope of the Parapet be faced with strong and hard Materials.

The Platform, or Gun-deck, of each Battery, may be laid in such a Manner that the Cannon may always have room to traverse, and to recoil so far as to give room to load quickly, for though the Gun will have but about ten Feet clear behind the Parapets to stand in, yet the Deck on which she stands being run at pleasure under the next Gun-Deck, it being about four Feet and a half in height clear, will give room sufficient for the Guns to recoil.

In each of the Embasures, which are to be through the Parapets, a Madrier or Stop may be

fixed,

fixed*, so as to rise up by the recoil of the Gun, and fall down again when she is run out; so that the Men on board may fight under very good Defences, which will be a great Means to save the Lives of many brave Seamen.

It is not improbable that it may be found practicable for a first Rate to carry, if necessary, twenty or twenty-five Guns on each Side, additional to the forty on the 'thwart ship Batteries; and that other Ships in like Manner may carry a proportionate Number, according to the Size of the Ship; all which Guns, for the greater Ease and Safety of these Ships, may be carried in Transports to the Place where they are to be fitted for action.

The Parapets here mentioned may be thought too heavy for the Ship, so as to make her crank, but as the Guns are not be mounted at Sea, and there being no Top-masts, Top-yards, &c. when the Guns are all on board, and the Ship all right, will make some amends for the Weight of the Parapets. Temporary, or false Decks, may be put over the Batteries on these Ships, to make convenient Decks at Sea, and when they are not in action.

I do not endeavour to give a particular Account of every minute Part of preparing such Ships; I only aim at being so far explicit, as to be understood by Men of capacity and practice.

* These Madriers may be so balanced by Weights, &c. that the recoiling of the Guns will easily hawl them up, having Pullies, &c. fixed for that Purpose, so that by this Contrivance the Men cannot be hurt by Musket Shot; and it is possible to make them so strong, and to fix it with such a Slope, as to make the Ball that strikes it glance upward, clear of the Men.

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C H A P. XI.

Of small floating Batteries, to batter an Enemy's Castles, Forts, &c.

FLOATING Batteries being so easily conveyed from place to place, especially in the prime of Summer, and the *French Coast* lying so near to *England, Britain* may send so great a Force before any one place on the *French Coast*, or any other neighbouring Coast, that the greatest Force that is upon any one Spot of ground shall in no case be able to resist it; I do not mean that all this mighty Power is to consist of great Ships of War, but only of a sufficient number of Sea fighting Ships, to convoy and protect the floating Batteries at Sea; for many of them, especially those of the first Line, will carry their Guns so low, that they cannot be fought at Sea, except the Sea is almost smooth; neither are the Guns to be mounted upon these low Batteries at Sea, except in fine Weather, when there may happen to be occasion for them to assist against the Enemy's Ships, &c. The Guns in the Vessels of the second and third Line, will be at a sufficient Height above water, to be fought at Sea.

Floating Batteries may be constructed in the following Manner.

To construct the low Batteries for the front Line, build Vessels with very flat Floors, and with proportionable Lee-boards*, like the reconnoitring

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Boats,

* According to the Idea I have of these Lee-boards, they will not only make Vessels sail well upon a Wind, but also in some measure prevent their rolling.

Boats, (Chap I.) about forty Feet broad, and about seventy-five or eighty Feet long, and very low; so that their Gun-decks (which is all the Decks they are to have) may be so low, that the Muzzles of the Guns be not more than one Foot above the Water †, when fitted for action; but when these floating Batteries are crossing the Sea, they will be a tollerable Height above the Water, having neither their Guns on board, nor the Water let into the Well they are to have.

The Holds of these floating Batteries must be ballasted and filled with Cork, or other light Material, in every respect as the Ships mentioned in the Ninth and Tenth Chapters, except that these Vessels are to have a circular Well, the whole Breadth of the Vessel, and down to her Keelson, to contain a circular Body to swim in it; upon which swimming Body a proper number of eighteen Pounders are to be planted, suppose eight, which will be moved round at pleasure, (the Body on which they are placed swimming within the Ship) and fired through narrow Embrasures in a good Parapet fixed upon the Vessel's Deck, and the Men stand safe behind the swimming Battery, to load the Guns under its cover at one Side, while the Guns are firing on the opposite Side toward the Enemy.

The Vessels which are to form the second Line of Battery, which is to lie behind the first Line, and which are constructed in the same manner, save that

* These Vessels being designed to carry a round floating Battery within them, they must be as broad as possible, in a moderate Length, to be able to keep the Sea, and contain a sufficient quantity of Cork, or other light Material, to swim them, like the Ships described in the Ninth and Tenth Chapters.

† Other Vessels being to shoot Balls over these Vessels, it will be proper to have them as low as possible, that the other Vessels may not be too high.

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that they may be deeper in the Water than the Vessels in the first Line, ought to have larger Guns, and their Gun-decks so high above the Water, that their Guns may safely shoot over the Vessels in the first Line.

A third Line of Battery, in like Manner, may be placed behind the second, and in some Cases a fourth Line of Battery may likewise lie behind the third; for Instance, when the first Line of Vessels can lye so very near the Enemy's Works or Defences as to admit of a good Space between every Line of Battery, and the rear Line of Battery lie sufficiently near: Secondly, when the Enemy's Defences are high, or upon a rising Ground, so that the Guns upon the Water must point much above the level to batter them. When as many Lines of Batteries are laid against a place as can do good Service, lay a good Number of Vessels with Mortars, at a proper Distance, behind all the Lines of Batteries.

That Nation who are Masters at Sea, may make use of many Contrivances to overcome Places of Defence upon an Enemy's Coast, and destroy their Ships in their Harbours; but at present I shall only give my Ideas of two other kinds of Sea-Batteries, which upon trial may, in some Cases, prove very serviceable.

The larger of these two sorts of Batteries are so to consist of flat-floored Vessels, constructed in the same Manner, length and breadth as those last mentioned, save that in place of Batteries swimming round within the other Vessels, here the whole Vessel is to be turned round upon the Water, (alternately changing Sides towards the Enemy) by means of such a Contrivance in the Ends of the Vessels, that the Enemy can neither see the Contrivance, nor shoot the Men that work the Vessel round, and the same Contrivance will force the Vessels to go ei-

ther a head or a stern, though but slowly, whither the water is deep or shallow.

To make this Contrivance, Openings on each Side the Keel must be in the Vessel's Bottom, as near both the Ends as can be, and built up a little higher than the Water-line the Vessel will swim at the 'thwart Openings to be six or seven Feet long on each Side of the Keel, and a Foot, or more wide; there must also be Openings lengthways, forward and aft, the Opening aft on the contrary Side of the Keel to that forward; these Openings to be of the same Length and Breadth with the 'thwart Openings. Hang two Lavers, or dipping Oars, of a convenient Length, in each Opening, the lower Ends of which must be thin, something like a common Oar Blade, to be pulled edgeways through the Water near the low End of the dipping Oars*, fix on Fins that by means of a Hinge will close together at the fetching of every Stroke like a thin Wedge, and extend directly, and hold much Water when the Stroke is given, the Ends of the Fins that open and shuts being well stayed to the Edge of the Oar opposite the Hinges.

The Guns are to lie in an Embrasure without any room to traverse sideways, but at liberty to shoot high or low; it is supposed every Gun will fire when the turning of the Vessel brings it right against the Object; each Gun is to have a Spring or Weight so as to recoil but a little Way; here is to be no Opening or Space between the Gun-carriages, and are to be solid the whole Length of the Guns and Carriages, and also four or five Feet Space between

* The dipping Oars in the 'thwart Openings will turn the Vessel round, and the dipping Oars in the lengthway Opening will give the Vessel head or stem Way; when there is not above fifteen Feet Water, long Poles put to the Ground, through these Openings, will have more Force than dipping Oars.

whither the Guns Muzzles, and the outside of the Ship, where Men are to stand and load the Guns, when that Side is turned from the Enemy, being covered by a Work raised upon the Space between the Breaches of the Guns mentioned in the next Paragraph.

Between the Breaches of the Guns on one Side of the Vessel, and the Breaches of the Guns on the other Side, is to be a Space of about nine or ten Feet wide, fore and aft, clear between the Breaches of the fore and aft Guns, well covered from the Enemy's Fire; the Deck or Floor of this place being at least six Feet below the Top of the Guns, there must be a Step set up to raise the Men who load the Guns: The Top of the Guns must lie near-level with the Top of the Parapet, (this Parapet formed by making a Part of the Breadth of the Vessel solid) which is to be about fifteen Feet thick, on each Side of the Vessel, stuffed with Matter which is most proper to resist the Force of Cannon-balls, with a Contrivance to wet the Materials in the Parapet, to prevent its taking fire. A low Vessel of forty Feet broad, and eighty Feet long, may carry five or six twenty four Pounders on each Side, with three pointing forward, and three pointing aft, with Ammunition, &c. and not draw more than four Feet Water: Before these Vessels enter in Action, their Masts and Rigging ought to be taken away.

The smaller floating Batteries are likewise to be floored, and to mount only four Cannon each, and draw about two Feet and a half Water. These Batteries may be serviceable in many Cases, they will be proper Vessels to go very near the Enemy, and in some places get under the Defences, to fire only the flanking Cannon, if any be, and must be able to bear upon them, which the floating Batteries

teries may soon silence, as they will be very greatly superior in Number of Guns; and their Balls flying much upward, will do great Damage to the Enemy's Defences; and if the Defences are Stone, will drive Splinters of stone upward, which will do great Execution in the Place.

C H A P. XII.

HAVING in the foregoing Chapters briefly described several Inventions, that I think may at present, or hereafter, be useful to my Country, and having in some degree shewn the usefulness of some of these Inventions, I shall now proceed to shew the Utility of old Ships of War, when fitted as described in the Ninth and Tenth Chapters: The Ships described in the Ninth Chapter are adapted to lay with their Broadides on, to muzzle Forts or Batteries, that other Ships, not so fitted, may pass by with greater Safety; they are also proper, if at any Time found necessary, to muzzle flanking Batteries, by laying between them and the other Ships, fitted as described in Chap. X. whilst they are battering any strong Fortification a head, and also to preserve Attacks by Sea, upon Batteries ashore, from being flanked by Batteries erected for that Purpose. When such Ships are well considered in all these Respects, I think they will appear to be of such Consequence and Service to *Britain*, as will induce some great Men to bestow a few Thoughts upon them; for such Ships cannot be sunk by Cannon, nor by coming aground, till they are dashed in Pieces; and the Men are well defended by the different Defences as mentioned in Chap. IX. besides, when the muzzling Ships are once laid in their Stations, all the Men, save two or three to look out in their Turns may preserve themselves where they think proper especially

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especially if it should be found that the fighting of their Guns would be of little Service. It will be easily conceived that all the Enemy's Fire cannot force these Ships from their Stations; and if they should attempt to burn, or cut such Ships adrift, there are sufficient Ways and Means to render these Attempts fruitless, by being moored with Chains, or having Frigates near, or other armed Ships; besides, each Ship may have a Tier of Guns and small Arms to defend her.

Damage in the Masts and Rigging must be expected; however, as much of these as possible may be taken away before they are sent to their Stations, and should there be a Necessity to bring some Ships off their Stations before the Business be done, they may be towed off with as little Risque as they were brought on to their Stations, of which hereafter.

The Enemy's Batteries will be effectually muzzled all the Time such Ships lie before them; these muzzling Ships cannot effectually secure the Rigging of Ships passing under their Cover, as the Enemy's Shot may fly over their Hulls, unless the muzzling Ships can lay very near the Enemy's Batteries at high water, so that their Guns must be pointed very high to fire over them, or that a great Number of Musqueteers, well fenced in the Ships, assisted by the Ships Cannon, can drive the Enemy from their Guns.

In the next Place is shewn the Utility of Ships fitted as described in Chap. X. which will, in some Measure, illustrate the Utility of the Ships described in Chap. IX.

It will appear (when the Construction of these Ships is rightly understood) that by having Ships fitted according to the Description in Chap. X. more than double the Force of what can be brought now by Sea, may, by this Method, be brought against

gainst Castles, Forts, and Batteries, that defend the Entrance into Harbours, &c. for a Ship having all her Guns pointed forward, so that as many Guns, to ten or twelve, can in the Breadth of the Ship be fired at once, against an Object, (the Ship lying with her Head toward it) as can be fired at once if the Ship lay with her Broadside to it; and as the Breadth of three Ships can lay in the Length of one Ship, and if the Length of the Bows-sprit be considered, four Ships may lay in the Length of one, with Room to spare; it is evident beyond Dispute, that more than double the Number of Guns can be fired from four Ships, lying with their Ends to the Object, (fitted according to Chap. X.) than can be fired by Ships lying with their Broadside to the Object, admitting there are as many Ships to bring before the Place to lay End on, as there is Room for, close before the Castle, Fort, or Battery.

The Number of Guns in the Length of a Ship's Side, will seldom be found in Fortification, above nine in one Tier, and in the Breadth of a Seventy Gun Ship, not above three, except there is in the Fort a high and low Tier of Guns, which indeed there are often, at the Entrances of Places of Importance; suppose there are two Tier, then there will be only eighteen Guns in the Length, and six in the Breadth, of a seventy Gun Ship.

A seventy gun Ship, fitted according to Chap. X. will (lying End on) be able at least to bring twenty or twenty-two Guns to bear against six in a Battery on shore, supposing two Tiers in the Battery, which is four to one, against the Fort or Battery. I am sensible that many Objections may be made against the Utility of the Ships fitted as described in the Ninth and Tenth Chapters, yet I know of no Objection but what may easily be answered.

Objection I.

Objection I. The Ships fitted as described in Chap. X. will be crank, and will scarce stand upon their Legs, especially to carry sail, the after Batteries with many Cannon being so very high above Water.

Answer. These Ships are not to carry their Guns mounted at Sea, except in fine Weather, when going from a Road or Bay; perhaps two or three Miles, to silence Batteries, &c. at the Entrance of Harbours, &c. and as such Ships will not carry above half the Number of Cannon they used to carry, before they were fitted in this Manner; and though the two after Batteries are high, the Batteries forward are lower, consequently has not above half the Weight to carry above Water they carried before, by which it appears, such Ships will not be much altered as to their sailing, but will be as stiff to carry sail, as other Ships of War, though most of their Guns are mouted.

Objection II. The Batteries aft having to fire over all the other Batteries forward, above one hundred and fifty Feet in length, will greatly incomode the Men, and endanger the firing the Ships, as the Wadds will not fly clear of them.

Answer. All the Wadds being made of woolling, and wetted properly for Service, will neither hurt the Men, nor fire the Ship.

Objection III. The Enemy's Fire will rake the Ship fore and aft, and do much Execution, having the whole Length of the Ship in a Line to fire along

Answer. The Slope of each Parapet takes its Rise about two Feet below the Level of the Top of the Parapet next before it, by which Means the Men are covered from the Enemy's Fire, somewhat better than if there were only one Battery, and one Parapet to fire at, as the Enemy's Fire will be diverted

verted amongst so many Batteries; and twenty Guns will destroy one or two Parapets ashore before* six Guns firing from a Fort can destroy five or six Parapets in a Ship, there being only five Feet in height of each Parapet, exposed to a level Shot, the fore Battery excepted; and as the great Talus, or Slope of the Parapets, will cause the horizontal Balls that strikes on them to graze, and perhaps leap clear of the Ship; and if any Balls shot from a high Battery go in below any of the Batteries Parapets, they must go in amongst Cork and Water, or where they can do little or no Harm.

Objection IV. Though there are Breast Works to cover the Men and Guns, if the Ships lie end on, there is nothing to cover their Broadfides against the Enemy's flanking Batteries.

Answer. There is the same Defence for these Ships Broadfides, as other Ships now have for their Broadfides; yet Ships are described in Chap. IX. that are to cover with their Broadside the Sides of the Ships that are to batter end on, by lying with their Broadfides against those flanking Batteries, which may be so situate, that Ships cannot at that Time lay with their Heads toward them.

Objection V. In five Parapets, one behind another, there are so many Embrasures, one behind another, that the Enemy's Shot cannot miss of hitting some
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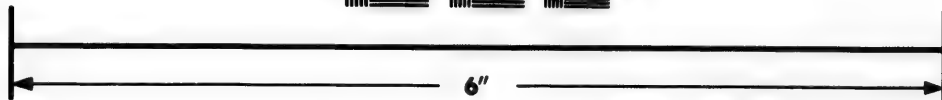
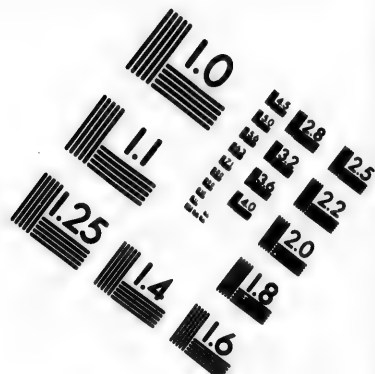
* If there should be exceeding great Batteries ashore, as several Tiers of Guns, and Parapet behind Parapet, to the Number of five or six, or more, as is very possible to have them so in some Places, the battering Ships may be relieved as often as is necessary, by others taking their Place; but the low floating Batteries will, I think, be found properest to attack such Batteries, as the proper Direction of their Shot flying upward will graze, and leap from one Battery to another, and do much more Mischief than Balls flying in a horizontal Direction; besides, the small floating Batteries drawing so little Water, will very probably get under the Batteries, that their Guns cannot bear upon them, especially the high Battery's Guns.

one or more every Fire, and thereby do much Mischief.

Answer. Though five Rows of Embrasures are one Row behind another, a Ball can do little more Harm by going through the formost, or any other Embrasure, than if there were but a single Battery, for whatever Embrasure the Ball goes through, it will go under all the Men in the Batteries behind that Embrasure, where it can do little Harm; beside, the Madrier contrived to fill the Embrasure by the Recoil of the Cannon, and to clear the Embrasure when the Cannon is run out, will add considerably to the Safety of the Men; add to this the Unequality between twenty Guns in a Ship at Sea, against six, or perhaps but two or three Guns in a Fort ashore, and that the six, or perhaps two or three Guns ashore (as is before mentioned) have five Breast-works or Parapets in the Ship to demolish, while the twenty Guns in the Ship have only two, or perhaps but one Breast-work or Parapet on shore to fire at, and two or three Guns to silence. There are other great Advantages on the Side of the Ships fitted as above, (*i. e.*) no Time need be spent or any Risque run, in letting go Anchors to bring the Ships properly up; in going before Castles, Forts &c. the Ships running in shore to engage Forts or Batteries with their Heads toward them, there is nothing to be done but to begin firing as soon as the Ships are within Gun Shot; the Ships may run bump ashore (first letting go an Anchor a stern, where a Windlass must be fix'd below) on a rising Tide with their Heads toward the Forts or Batteries if the Ground is good, and let fall from within their Quarters* strong Barks of Timber, well shod

* A strong Case or Coffin must be made a convenient Distance from each Side of the Keel, and two or three Feet below the Ship's





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shod with Iron, to go into the Ground, to hinder the Ship's casting athwart in a gentle shore Swell, as mentioned in Chap. III.

Objection VI. So many Cannon firing so near over Mens Heads will stun the Men and make them unfit for action.

Answer. This Objection has seemingly some Reason in it, but I have observed the Concussion made by the Explosion of a Cannon diverges very little; a Cannon fired in a narrow Embrasure of Earth, whose Sides were about a Foot and a half clear of the Gun's Bore, the Concussion made but little Impression upon the Sides of the Embrasure, and what Impression appeared it was but a very small Distance before the gun, and the Impression was less upon the Bottom of the Embrasure, though the Bottom was as near the Gun as the Sides. From these Observations it may be imagined a man may stand safely ten or twelve Feet Distance before a Cannon, provided the Crown of his Head is about two Feet below the passing Ball; or the Men in the Batteries need only step under the Parapets next behind them, and stay there about half a minute, or the time the guns next behind them are firing, and no Harm can come to them from their own Guns.

A few Experiments upon the Head of a Dog or other Animal, will clear the Point, and fix exactly how near a Man's Head may be to the Muzzle of of a Gun when fired, and receive no uncommon Harm.

The Guns in Forts and Batteries ashore that lie low, are supposed to do the greatest Damage to Ships,

Ship's Heal; in which Cases or Coffins must be hung strong heavy Oak Balks, shod with Iron, to let drop into the Ground as soon as the Ship touches forward.

These Balks may be easily let down and hove out of the Ground when there is Occasion, by a Purchase fixed for that Purpose See Chap. III.

Ships, but those Guns will be of little Service against the Ships here described, as doth appear in the Course of this Work, which is another great Advantage these Ships have over Batteries ashore, and it is, I think, very plain these Ships have double the Advantage of the Sea-fighting Ships against the Forts and Batteries ashore, and when the Advantage shipping has by this Method over Forts and Batteries ashore is known, the present Fort will not engage shipping upon such unequal Terms.

If I remember right, it has hitherto been allowed that Ships of War, getting within a Cable's Length of a Fort, have the Advantage of common Forts, if so, great Things may be hoped from Ships being able to carry double that Force in the same Space, (*i. e.*) in the Length a seventy gun Ship takes up before the Fort (whose Broadside is only thirty-five Guns at most) three seventy gun Ships, and if the Length of the Bowsprit is considered, four seventy gun Ships may lie end on, in the Length of one seventy gun Ship, each of which can fire at least twenty Guns as quickly, and with more safety, than a Ship can fire her Broadside; here is eighty Guns in the place of thirty-five, or perhaps but thirty-three; and Forts will be laid under greater Disadvantages, by this Scheme, against eighty Guns, than they have hitherto been under against thirty-five Guns; for instance, the low Batteries ashore at the time the Tide is high will be of little Service against these Ships; and as it is very evident that Ships have with their present Force often silenced Castles and Forts, and then have gone into Harbours and destroyed Shipping, &c. It certainly will be allowed that Ships which not only have more than double the Force they have hitherto had, but also have other considerable Advan-
tages,

tages, will with reason disregard and despise the Force of Castles and Forts on shore*; and the Nation who are Masters at Sea, will also be Masters of all the Harbours in *Europe*, until every Power, who has Harbours and Ships to secure, has erected stronger Defences, and is at a great Expence to maintain them

* It is allowed a first Rate Man of War's present Force is about four or six Guns to one that Common Batteries have in the same compass, but a Ship's Motion has been spoken of by some in a manner tending to insinuate a Belief that Ships always have so great a Motion, they cannot hit a Battery, save some chance Shots, and therefore Batteries on the Shore has (through the Ship's Motion only) so great an Advantage over Ships, they may sink every Ship that dare to come near them.

Now as there is only the Motion Ships has to object against their having the Advantage of Batteries, there cannot be any Objection when Ships has not a Motion to hinder their hitting the Batteries, and it is known, beyond Contradiction, that in the generality of Summers, there are three or four Months in which Ships may, for the most part, lay before Batteries at the Entrances of Harbours, &c. and not have so much Motion as will make a practical Gunner shoot uncommonly wide of his Mark.

As to keeping the Battery's Guns ready to pour all their Shot into the Ship when she comes near and opposite, this the Ship may very easily avoid, as Batteries may be destroyed by oblique firing, and a Ship in many Cases need not come where all the Battery's Guns can bear upon her.

There are many strong Batteries that two Ships in fine weather may destroy with little Damage to themselves, by oblique firing, the Ships lying at the extream Ends of the Battery, where few of the Battery's Guns can bear upon them; Ships has great Advantages when they are manageable, and can be laid in any Station.

From common Knowledge, and from what has been said, it is self-evident that if it can be contrived to construct Ships that will carry double the Number of Guns in the same Compass, no Batteries, yet in being, can be able to withstand them.

C H A P. XIII.

Of the Means Britain has to take or demolish an Enemy's Sea-ports, and destroy their Ships in Harbour.

HAVING in the foregoing Chapters treated of several Inventions that those who are Masters at Sea may make use of, in order to master an Enemy's Sea-ports, and destroy their naval Power, I will in this Chapter treat of the Application.

In order to make it appear in a proper Light, that *Britain* has the Means to demolish an Enemy's Sea-port Towns, Forts, and Batteries, and consequently be Master of the Harbours, and may destroy the Enemy's Shipping, let it be supposed, a sufficient Number of Ships, with low floating Batteries, &c. are prepared according as described in the foregoing Pages, and the Fleet ordered to go into *Brest* or *Toulon*, and take or destroy the *French* Ships there.

If any Advantage is to be gained by unexpectedly and suddenly attacking the interior Force at *Brest*, *Toulon*, or any other Sea-port; I mean if any Advantage can be gained by sea fighting Ships running, at their first appearance, directly past the enemy's Forts and Batteries, into their Roads and Harbours, (being covered in their running past the Forts and Batteries by muzzling Ships) and attacking their Ships in their Roads and Harbours; and the muzzling Ships, that covered the sea fighting Ships in running in, to lie before the Batteries that are within, if necessary, while the sea fighting Ships take or destroy the enemy's Ships.

The Ships that are to muzzle Batteries must be well fenced; and when ordered to duty must carry

as few Men as possible, and have very little Rigging, with as many Chains instead of Ropes as can be used; and if they are to lay before Batteries must only have their lower Masts and Sails, the Yards to be let down upon Deck when the Ships are got to their Stations.

Having a good Opportunity, the muzzling Ships and sea fighting Ships ought to sail forward in their proper Stations (*i. e.*) a close line of muzzling Ships on each Side the sea fighting Ships, if the Entrance is narrow, and Batteries on each Shore, in order to receive the Enemy's Fire from their Forts and Batteries, with a sufficient Number of muzzling Ships in the Van, to be ready to lay before the Batteries that are situated to rake the Lines of Ships while in the narrow Entrance; (for without doubt there are strong Batteries to enfilade, as much as possible, every Course and Channel leading into *Brest Road, Toulon*, and other principal Harbours in *France*) as the Ships whose Holds are filled with Cork cannot be hurt by coming aground, unless upon a high sharp Rock, when it is falling water, or except there is a Sea to break them to pieces, the muzzling Ships may make bold, especially in a flowing Tide, and steer near in shore, and so run close to the Batteries, which about the Time of high water will effectually muzzle them; and as by loss of Masts, &c. it may be expected the Sails of many of the muzzling Ships will be rendered almost useless, therefore a stout Towline must be fastned from Ship to Ship, one Tow-line between every two Ships; the End passing into each Ship about eight or nine Feet, or a sufficient Depth, under water, to be clear of the Enemy's Shot, near the Stern-post, and at the same Depth under water, as near the Ship's Cut water as may be; so each Ship has the End of

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a Towline Forward, and the End of a Towline abaft, to slack out or hawl in at pleasure.

When muzzling Ships are either to sail along with other Ships to cover them while passing Forts and Batteries, or to lie before Batteries, they must be as close stem to stern, as the smoothness of the Sea will permit them; and if any of the muzzling Ships are disabled, which can only be in their Masts and Rigging, the headmost Ships not being disabled in their Rigging will both tow the Ships a stern off, and keep them in their Stations, by Means of the Towlines before mentioned, for no Damage in the Hulls need be feared; but as the headmost Ships are as liable to be disabled in their Rigging as the other Ships, they cannot be depended upon to tow, or any otherwise assist the Ships a stern; and as the muzzling Ships must get as near the Batteries ashore as possible, otherwise they cannot cover the Rigging of the sea fighting Ships. It is not very practicable for the sea fighting Ships to tow the muzzling Ships, so as to answer any very good Purpose, which makes it absolutely necessary to be prepared, and able to make the headmost muzzling Ships go a-head, and keep their Stations, though disabled in their Rigging; There may be several things contrived for this Purpose, though the Enemy's Shot may render most of them unserviceable; in speculation there appears a Contrivance which will answer this End; but Experience must confirm it, by making an Experiment according to the following Manner: Let each of the headmost muzzling Ships have one or two very large Cannon, or a proper mortar or two pointing forward, (perhaps it may be found necessary to cast Cannon for this particular Service) with Chains fix'd to Balls to be fired out of the Gun or Mortar, a proper Anchor being fastened to that End of the Chain which hangs out of the Gun or

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Mortar

Mortar, and a Towline bent to the Chain at the Anchor, and coiled so as not to entangle when the Anchor is thrown out a head by the Gun or Mortar being fired: Though it cannot be expected an Anchor of any considerable weight can be thrown out to a useful Distance by this Method, yet upon Trial it may be found that Anchor after Anchor, of a small weight may be thrown out, by which the Ships may be warped past Forts and Batteries; but if the muzzling Ships are only to lay before Forts and Batteries till other Ships pass, they may at any Time easily be hawled off, either a head or a stern, by Towlines bent together for this Purpose, and the Ships having the End with them*.

Thus the Lines of Ships are to proceed in close order, always keeping, if possible, the muzzling Ships against the Enemy's Cannon, while passing within gun-shot of the Enemy's Forts and Batteries; and when the Ships are got near the Enemy's Batteries in the Harbour, &c. the muzzling Ships are to lay before those Batteries, if need be, while the sea fighting Ships are engaged in destroying the Shipping.

The Ships that are to batter with their Ends on, and the low floating Batteries, to follow close a stern of the Ships that are running past the Batteries, and begin firing upon the Forts and Batteries as soon as possible; and if there is sufficient Room, the Forts and Batteries should be attacked at the same time the sea fighting Ships are running past, or rather sooner; but of this hereafter.

If it is apprehended little or no Advantage is to be gained by a sudden or unexpected Attack, the following

* It is scarce worth mentioning that Ships may carry the End of a Towline any Distance, by having the Coil on board, and letting the rope go properly out, as the Ships move forward.

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following Method may be taken to silence the Enemy's Forts and Batteries, so that sea fighting Ships may safely run past them into Harbours, Roads, &c.

Admit a Design is formed to destroy Ships in Harbours whose Entrances are well defended by strong Batteries upon the Shores, and it is thought most advisable to silence those Batteries before the sea fighting Ships attempt to enter (though covered by muzzling Ships) to perform that Service.

Being arrived conveniently near the place of Action, in the prime of Summer, take the Opportunity of low Water falling soon in the Morning, to order the floating Batteries, Bombs, &c. to get before the Place designed to be attacked, a while before low Water, (if the Tide doth not ebb too far from the Batteries ashore) and in the following Order:

The small Batteries that draw about two Feet and a half of Water are to move forward in the Van, and form the first Line before the Place; and if there are strong flanking Batteries, muzzling Floats, that draw no more Water than the small floating Batteries, prepared for that Purpose, must be laid before them; such muzzling Floats are so easy to construct, if what is said in the foregoing Chapter be considered, that it would be superfluous in this Place to give a Description of them. The first Line of Battery, composed of small floating Batteries, must be followed in proper Order by as many Lines of larger floating Batteries as can lay sufficiently near, and safely fire over each other to good Purpose; and as the first Line will probably get very near * to the Batteries on shore, it may be sup-

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posed

* I am little acquainted with the *French* Manner of making Forts and Batteries to defend the Entrances into their Ports, but if the Forts and Batteries I have seen at home are examined by

posed four Lines can bring their Guns to bear, and that every Line at each End is about a quarter of a Mile longer* than the Batteries on shore, if the Situation will admit; these Lines of Battery to be followed by as many Bombs as can lay behind the rear Line of Battery, and play to good purpose.

If, notwithstanding all this Force, the Batteries on shore, by well directed Balls, disable many of the floating Batteries, and oblige them to hawl off at about two Hours Flood, which is proper Time for battering Ships, described in Chap. X. to advance, with Bombs under their Sterns, as before mentioned, and make a fresh Attack upon the Forts and Batteries, it being reasonable to imagine the floating low Batteries has not left the Forts on shore in a very good Condition; I think the shattered Batteries on shore cannot long resist so great a Force as the battering Ships, described in Chap. X. but, for the sake of Illustration, let it be supposed,

The Batteries on shore be wonderfully strong, and regularly supplied with fresh Men, and also Guns as soon as any are dismounted, so that after some

by proper Men, it will be found that the low floating Batteries here described, may, in the last Hour of the Ebb, and the first of the Flood, do much Mischief to the Defences, and the Forts and Batteries ashore cannot bring any considerable Number of Guns to bear upon them; and low Vessels, properly filled with Mortars, Coe-horns, &c. may also do much Mischief with a good deal of Safety.

* The Lines of Battery here spoken of, being considerably longer than the Batteries they oppose, will by their Length have an Advantage, both in regard to their Number of Guns, and the oblique Direction of the Shots fired from the Ends of the Lines, for by an oblique Direction the Balls have a better Chance, not only to dismount the Enemy's Guns, but by crossing the Shots made from the Batteries in the Front will do greater Damage to the Defences.

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some Hours battering the Ships* are also obliged to hawl off; if this should be the Case, which is very improbable, seeing the Force of these Ships is so great, the low floating Batteries by this Time (the Men being refreshed, and the places of the disabled Batteries supplied by others) will be ready to advance again as at the first, and begin a fresh Attack. Thus may the battering Ships, and also the low floating Batteries, alternately relieve each other, at a proper Time of tide, till no Defences on shore, yet made or invented, can resist them any longer. And

Vessels can arrive so unexpectedly before places situated by the Sea, that it cannot be in the power of any Government to know with any degree of certainty, what Place will be attacked, and to provide every place with a Garrison uncommonly numerous, and a double or treble number of Cannon, would be too great an extra Expence perhaps for any Nation to bear, even but for a few Years; therefore it is very improbable, if not impossible, that any Place will make so great a Defence as is here imagined; and if it is possible to make so great a Defence as is here described, yet they will be silenced after they have done all they can, as the floating Batteries can be so easily relieved, and new Batteries laid before the Place time after time, as often as there shall be occasion.

This will be reducing our Operations by Sea, against an Enemy, to some certainty at a small Expence, compared to the Expence and Risque of keeping strong Squadrons on an Enemy's Coasts to watch their Motions, the Effect of which is somewhat uncertain.

F 3

That

It is shewn in Chap. XII that these battering Ships lying with their Ends on to batte, in the Length of a Ship are more than double the Force of a Ship's Broadside.

That *Britain* has the Means to do any possible Thing by Sea, is evident from the great Number of Seamen now in the royal Navy; and it is well attested there are full as many left for other Employments as can find entertainment in the Merchants Service; as for Materials for building and repairing Shipping, *Britain* itself affords much good Timber and Iron, &c. and has Money to purchase any quantity of other Materials that can be wanted; and there need be no want of Shipwrights if every Shipwright in his Majesty's Dock Yards were allowed a Servant.

I will not undertake to enumerate the Advantages that will accrue to the Nation who is strongest at Sea, by putting the Schemes here laid down into practice, and by being Masters, not only of all the Harbours in *Europe*, but in every other Part where any Advantage appears; and not only destroy the naval Power of *France* for the present, but limit that Power to a certain Number of Ships of War for the Time to come. This would be a Blessing to all *Europe*, if the Nation whom God has blessed with the strongest naval Power continue to fear God and love their Neighbours, in taking away many of the Causes of Contention, and consequently prevent the shedding of much christian Blood; for if the Accounts I have read and heard be true, there have been few bloody Wars in *Europe*, amongst Christians, in the two last Centuries, that have not been either begun or prolonged by the Intrigues of *France*; therefore if *Britain* at this Time* will enter heartily upon destroying the naval Power of *France*, and the other Powers of *Europe* countenance the Design, to prevent *France*, as much as possible, from ever being any considerable maritime Power for the future. This would certainly

* Written in the Year 1758.

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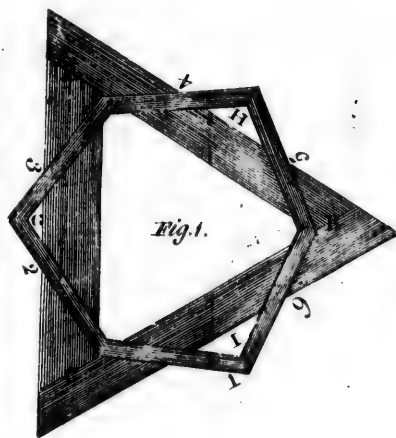
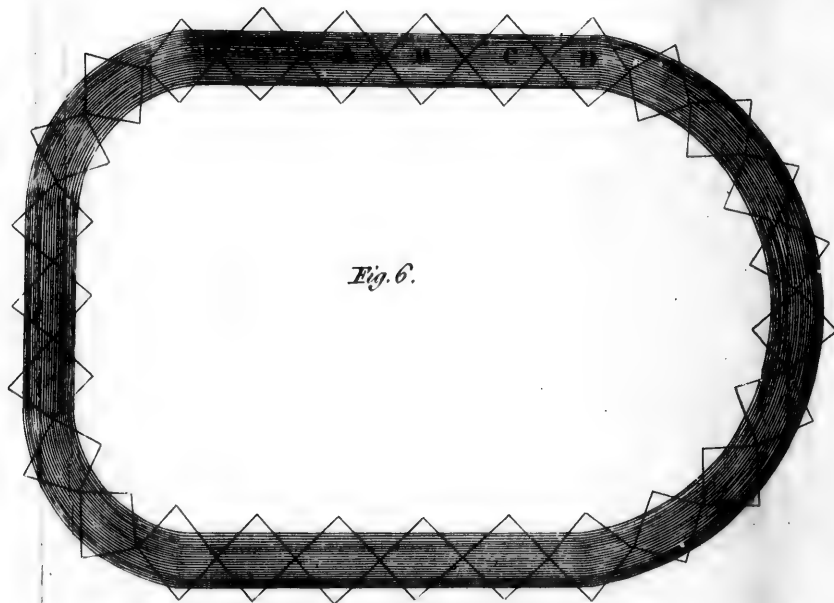
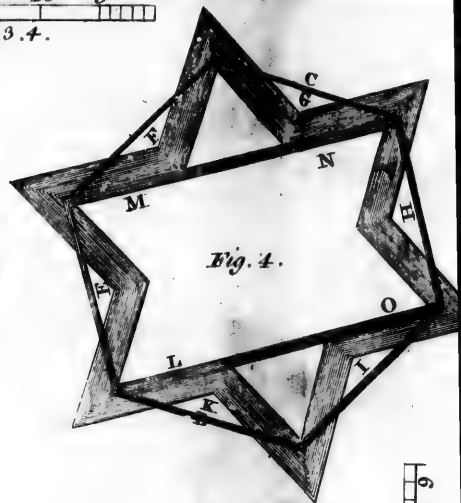
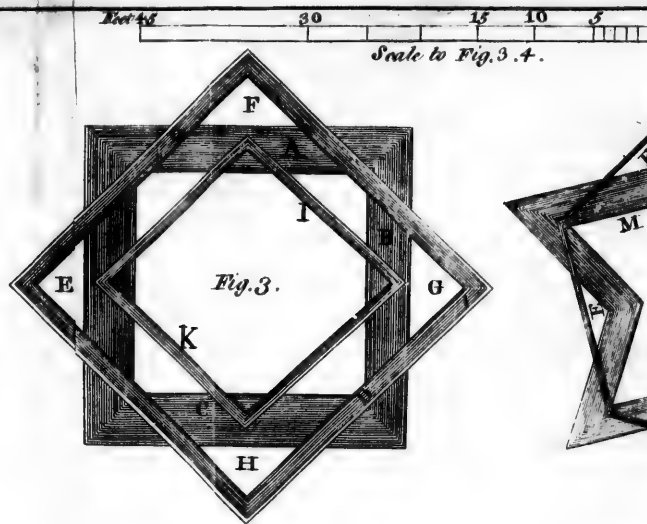
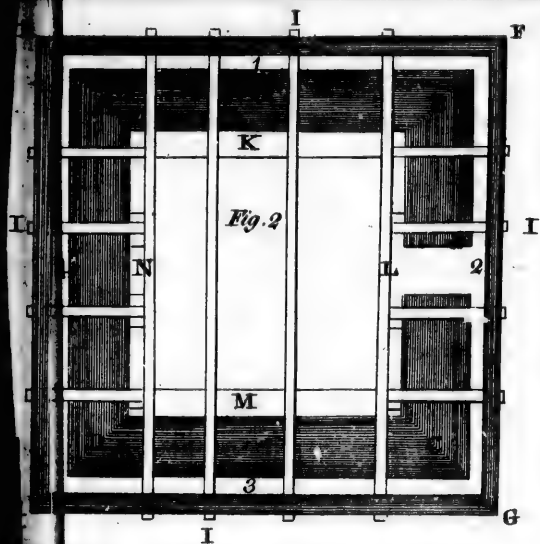
ly be the greatest Good done to Mankind, by mortal Men, since the World began.

There might be given a long Account of the restless Spirit of the *French* Nation, and their breaking through all Treaties, not regarding Men's Lives, nor the Distresses of the Innocent, but obliging Nations to arm in their own Defence, which has been the Cause of a great Effusion of christian Blood, and the Distress of many Thousands of innocent People; but as all that I can say on this Head is well known, it would be an useless Digression to enlarge upon that Subject in this Place.

It being the *British* Trade that chiefly supports and supplies the *British* Power, therefore *Britain* ought always to look upon every Encroachment upon her Trade, by a powerful Rival, as greatly dangerous, not only to her Laws and Constitution, Liberty, and Property, but to her being a Kingdom.



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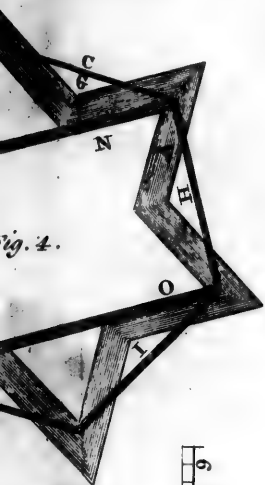
Scale to Fig. 3. 4.

Scale to Fig. 6.

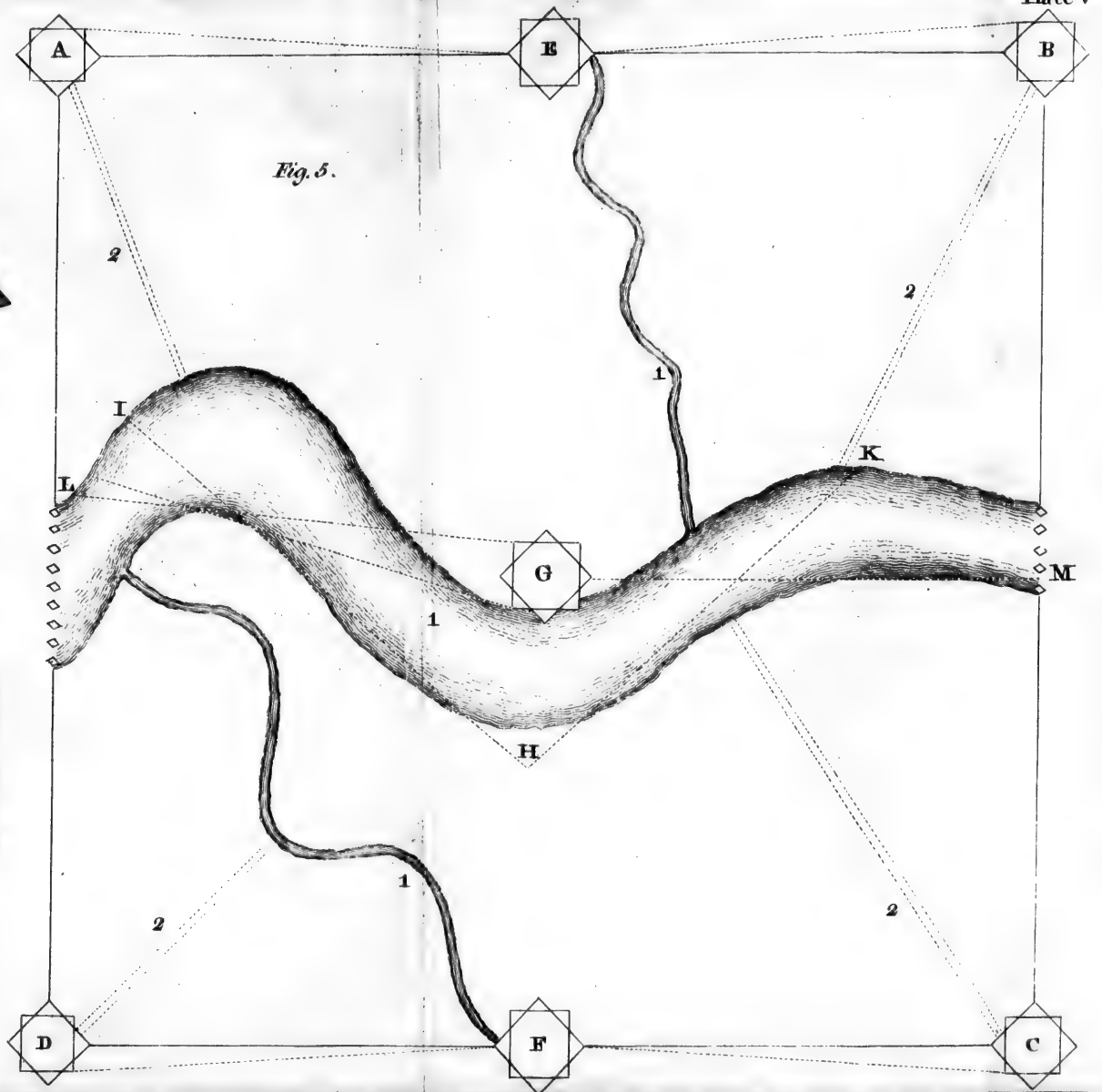
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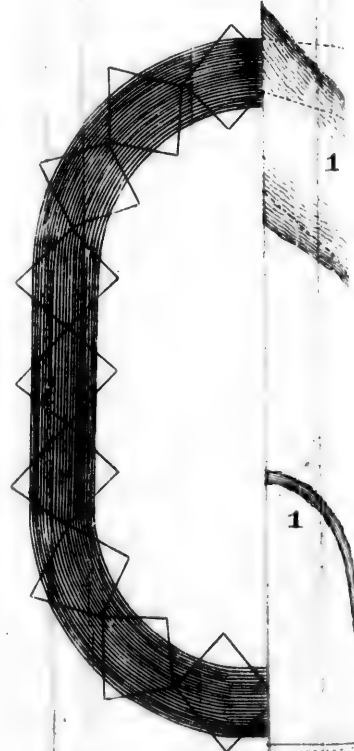
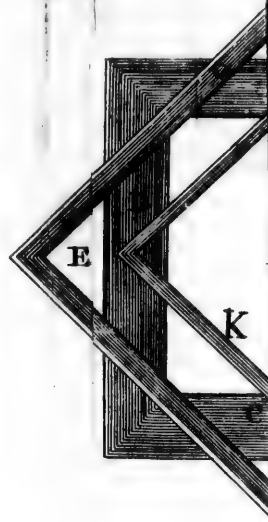
Fig. 5.

Fig. 4.

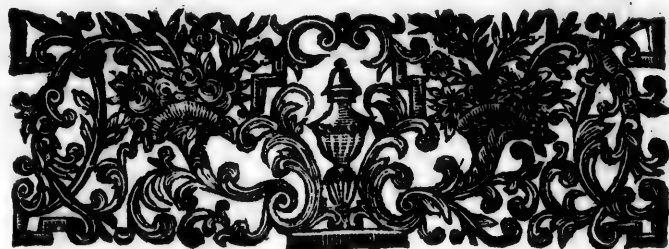


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P A R T II.

C H A P. I.

Of Fortification.

1 **A**S the Art of fortifying Houses is useful in many Cases, especially in civilizing a savage People, and making Plantations amongst them, I will in this Chapter shew several Methods of building dwelling Houses that cannot easily be taken without Cannon ; the Art of fortifying small Places is called Fortility, and the Places so fortified are called Fortlets, or Fortins.

This sort of Fortification was much used in the North Parts of *England*, before the Union of the two Nations, for the Inhabitants upon the Borders frequently plundered each other, taking away Sheep, Cattle, Horses, &c. even in time of Peace ; this made the People on the Borders think of securing their Property, by building strong Houses, many
of

of which are yet standing in the northern Parts of *Northumberland*. But,

As those People knew little of Fortification, they only built their Houses of Defence a little stronger than common Houses, with Spouts above the Doors, to convey hot Water, &c. upon any one that should attempt to break or burn the Doors; some of these Houses has a Place at the Top of the Gavel End, or Pitch of the Roof, right above the Door, projected upon stone Corbels, from where they probably threw Stones, &c. upon those who came near to break the Door; they also laid a Heap of large Stones, or built a small House with strong Walls, a little Distance from the Door, to prevent any Thing of the nature of a battering Ram from forcing the Door. These Houses are divided into a low and high Room, by great Beams covered with Rice or small Wood laid across them, over all which are laid a considerable Thickness of Earth, to make a Floor; they secured themselves in the upper Room, and there Cattle, &c. almost every Night in the lower Part, especially if any Tidings came of the Approach of the Moss-Troopers, for so they called the Men who generally came to plunder. That those Houses were of great Service appears from the great Number of them, there being few old Villages near the Borders, that has not one or two, or more of such strong Houses; and if Fortility were well improved, and properly put in execution, it would prove a very considerable Security to the *British* Settlements in *America*, especially the Settlements most liable to be attacked by Parties of Indians; for very little more Labour and Expence is required to build a Fortin, or Fortlet, than is required to build a common dwelling House, and three or four Men may defend a proper constructed

structed Fortin, against a considerable Number of Indians, or even regular Troops, without Cannon.

PLATE V. Fig. 1. *Construction of an equilateral Triangle Fortin.*

A, B, C, the ground Plan, which may be raised any convenient Height above the Level of the Ground, suppose eight Feet, or one Room in height, sixteen Feet, or two Rooms high, &c.

1, 2, 3, 4, 5, 6, the Plan of the upper Part, which well defends the Triangle under it, through the Places marked G, H, I; Care must be taken to raise the Points A B C that Men cannot get upon these Points; the Entrance to be through G, H, or I, in Time of Danger, with a Ladder, as mentioned in the Description of Fig. 2.

Fig. 2. *Construction of a Square Fortin.*

A, B, C, D, the Plan on the Ground, E, F, G, H, a Parapet, Musquet proof, six Feet high, its Base supported by Timber, as I I I I, ten Feet high from the Ground; but if it is required to have the House three Rooms high, the Wall A B C D to be the Height of two Rooms; 1, 2, 3, 4, the Place where the ground Plan is defended; the Door to enter the House to be about seven or eight Feet high from the Ground, having a broad step Ladder, in manner like a Draw-Bridge, to be drawn up every Night, or when any Danger is apprehended; K L M N the Walls of the upper Room or upper Story, on which the Roof is built; the Roof and the Space, A B C D, to be covered with Earth, that Hand-Granadoes, or Fire, may do no Mischief there, if thrown by an Enemy.

The Wall of the lower Part of these Fortins ought to be from four to six Feet thick, according to the strength of the Material they are built with,
and

and if it be possible they must be built with Materials that cannot be set on fire, as also should every other Part of the Outside, if the Materials are to be had at a reasonable Expence; if such Materials are hard to be got, the upper Parts may be built of Timber, cased with Boards or Slabs of dead Sap, for dead Sap will not burn itself; but if Lime can conveniently be got to case the upright timber Work with a strong Coat of Plaistering, that will preserve the Timber from fire, and also endure the Weather, it will do better; if the Roofs of such Buildings are covered with Boards or Shingles, they may be well turfed, when any Danger is apprehended, but the Turf should be thrown off when there is no Danger of an Attack, for if the Turf is continued upon the Roof, and Water get through, the Boards or Shingles under the Turf will rot very soon.

Fig. 3. *A second Method to construct a Square Fortin.*

A, B, the ground Plan, constructed in all Respects as A B C D in Fig. 2; C, D, a Parapet with Angles, projected over the middle of the Walls, upon the ground Plan, which Angles form the Spaces E, F, G, H, through which the Faces of the Walls may be well defended; K, I, the upper Story, or Seat of the Roof; as to the Door or Entrance, see the Description of Fig. 2.

Fig. 4. *Construction of a Fortin Star.*

The Parapet, C, D, make a Defence to every Front of the Star, as E, that there is no need of Openings in the lower Wall to fire through; the Door or Entrance is through the Opening E, in Time of Danger, with a Ladder to let down and hawl up at discretion: See the Description of Fig.

2. L, M, N, O, the Walls of the upper Story, and Seat of the Roof.

The principal Part in making Settlements, are, first and above all, to fix upon a proper Spot of Ground for a Plantation, near a River or Brook, or at least where is a sufficiency of Water; and if the Situation is near a treacherous Neighbour, a particular Regard must be had to place the Fortin or dwelling House, as far as possible from any Hill or other Place, behind which Men may approach the Fortin unseen, and conceal themselves till a proper Opportunity offer, to surprize it; and if the Fortin or dwelling House is by a River, as G, Fig. 5, it should be so placed that as great a Distance upon the River as can be, both upward and downward, is seen from the Fortin; and it may be proper to erect a tall Pole upon the Top of the Fortin, to hoist a Flag, or a Light upon, with a Convenience to get up to its Top, to look out, &c.

Fig. 5. shews how any of the Figures, 1 2 3 4, in Plate V. may be adapted to defend a Plantation, or Space of Ground, and also secure the Owner and Family, from almost any Number of Men without Cannon.

Suppose G and H, Fig. 5, are Fortins upon the Brink of a River, it is evident H commands the River no further than I and K, but G commands the River from L to M, therefore G is the better Situation in respect to commanding the River, and as Musquets will kill Men at the Distance of three hundred Yards, the Fortin G will defend a Piece of Ground six hundred Yards square, and if the Fortin is properly constructed, and defended by eight or ten active Men, it is hardly possible to take it without Cannon, while Victuals and Amunition last in the Fortin.

Admit

Admit four, six, or more Families agree to have their Plantations lie together, and build Fortins that will not only defend each other, but can also defend their Plantations.

Fortins for four Families, as A, B, C, D, Fig. 5. placed three hundred Yards apart, so that they can well defend each other, will have near one hundred and sixty-eight Acres of Plantation, within Musquet shot, which they can well defend; and if it is thought each Fortin has a sufficient Defence for itself, they may be placed six hundred Yards apart, and have near two hundred ninety-eight Acres within Musquet shot.

Fortins for six Families, as A, E, B, and D, F, G, Fig. 5. being placed three hundred Yards apart, will have near two hundred and twenty-four Acres within Musket shot, which the Fortins can well defend, and likewise will defend each other; and if it is thought proper to place six Fortins six hundred Yards asunder, they will have near four hundred forty-six Acres of Ground within Musquet shot, and so on in proportion, as more or fewer Families have their Plantations lie together.

In any Place where it may be necessary for many Families to dwell together, a Fortification against small Arms may be formed, by building Houses with their Angles meeting together, as A, B, C, D, &c. Fig. 6. so that the other Angles form Redans all the way round the Town; in Time of Danger the Horses, Cattle, Sheep, &c. may be secured in the Space of Ground inclosed and defended by the Houses.

The Roofs of these Houses being one continued Roof round the whole Town, so as the Roof will hang or project a good way over the re-entering Angles or Coyns of the Houses that meet together,
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and so form a good Defence for the re-entering Angles, and add much to the Defence of this sort of Fortification.

There may be as many Gates or Entrances through the meeting of the Angles or Coyns of the Houses as is necessary; and the entering into the Houses, turning the Roof, &c. in Time of Danger, to be as mentioned in the Description of Fig. 2.

It will be superfluous to trouble the Reader with Arguments to prove that Houses, built in the Order as Fig. 6, will not cost more than if such Houses were built in any other Order or Situation; neither need any thing be said to prove the Advantages of such a Disposition of Houses, the Advantages being evident, especially in such Countries as *America*, where the Planters are not safe with respect to their Neighbours.

C H A P. II.

EXperience has fully proved that the present Fortifications cannot long preserve Cities and Towns, against a numerous and well provided Army; nor stop its Progress, so as the Advantages of such Fortifications are superior, or even equal, in many Cases, to the Expence of building and maintaining them, a few Places of particular Situation excepted. And,

As so many eminent Men of great Experience, in so many Ages, have endeavoured in vain to render the Advantages of a Fortification equal to those of the Attack; I think it may with reason be imagined impossible, without adapting an entire new Method of Fortification: But whether a new Method of greater Advantages can be invented is a
Question

Question not easily determined; for so long as the Besiegers have it in their Power to bring as great Numbers of Cannon, Mortars, &c. against a Place, as they please, and can erect Batteries with as resisting Materials as the Batteries of the Place are of, no Fortification, that a reasonable Man will be at the Expence of, can be built by the common Methods of Fortification, and in a common Situation, but what may soon be taken.

Having considered that the first great Step toward taking a fortified Place, is the silencing the Besieged's Fire to such a Degree, that the Besiegers can carry on their Works with tolerable safety, and erect their Batteries sufficiently near the Defences of the Place. And

Having also considered, that notwithstanding the Besiegers has the Advantage of a much superior Fire to that of the Besieged, if any practicable Method can be found to prevent the Besiegers from dismounting the Besieged's Guns, Mortars, &c. Places may hold out much longer than they generally do at present, and cost much more Time and Expence to get Possession of a fortified Place.

It doth not appear to me impossible to erect Batteries whose Guns the Besiegers cannot dismount any other way but by Mines, which in a watery Situation may also be prevented; and such Batteries may likewise be built in a dry Situation, that the Besiegers will find extremely difficult to blow up, especially those erected in the Body of the Place.

In order to gain these Advantages, Embrasures, Guns, Carriages, &c. must be made of a new Construction; and I hope I am able to demonstrate that by altering or making new Batteries in the Fortifications already built, some considerable Advantages

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Advantages will be obtained, on the Side of the present Methods of fortifying.

As to the new Method of fortifying, herein attempted, the Ideas are very much different from any that have yet been publish'd, or put in Practice, that I know of; the Largeness of the Bastions, Flanks, &c. or the Number of Outworks, are but little depended on in this Method, for Defence; it is here attempted to show how a Fortification may be built that will not require so many Troops to defend a Place, as the present Fortifications require, and yet make a better Defence; and that a small Place, defended by a Hundred, or two Hundred Men, shall cost an Enemy, either many Men, or much Time to take it; and notwithstanding I have spent much Time in making Models and consulting Enquiries on the Subject of Fortification, I can say with much Truth, that I have no particular Interest of my own to serve, by the Improvement of Fortification; save the Satisfaction I may have in being instrumental in procuring to those who are peaceably inclined, a Security against the ambitious Views of the Disturbers of Peace.

As the Materials here proposed are expensive, the Batteries must be as small as possible, to answer the Purpose; a Surface, or Plan, about equal to seventy Feet square is sufficient to make a strong Battery, if built with the Materials here proposed, and contain several Tiers of Guns.

What appears the worst to overcome, in the Manner of fortifying here proposed, is, the Smoke of the Guns in the cover'd Batteries, which not only hinders the People in the Batteries from seeing round them, but renders it impossible for Men to continue in close Batteries, to fire the Guns any considerable Time; but the Batteries here proposed, are in a Degree open behind, and may have fresh

Air injected, to prevent the Smoke from becoming intolerable to those who are appointed to work the Guns.

A Town has generally many Persons in it who are of little Use in its Defence, but by different Contrivances every Person that can do any thing, may find Employment in the Defence of a fortified Place; admit a square Battery (of six Guns on each Front) erected according to the Plans 1. 2. 3. Plate VI, with the Materials before mentioned; the Imbrafures little wider on the Outside, than the Guns Muzzles will go through; Bomb-proof above, and Vents, or Openings, in proper Places, especially one in the Middle behind the Guns, of thirty, or forty Feet square; the Guns, (in such a Battery as this,) being fired but a few Times, will fill the Place with Smoke, notwithstanding the Vents and Opening in its Middle of thirty or forty Feet Square; so that no more firing can be there till a considerable Space of Time after; in which Time an Enemy may gain great Advantages: This being the only Reason Case-matted Flanks are not made in late built Fortifications, tho' they are of the greatest Utility, if they could be kept clear of Smoke; and it appearing to me very practicable that the Persons, who are otherways useless in the Defence of a Place, may inject Air into any Battery that has proper Vents for the Smoke to fly out; so that the Guns in such Batteries, as mention'd above, may be fired with as little Difficulty, from the Smoke, as the Guns in an open Battery can be fired in calm Weather.

In order to keep a close Case-matted Battery tolerably clear of Smoke, make a Bomb-proof Place under Ground, or in such a Situation that the Besiegers Guns and Mortars cannot demolish it; this Place must have Rooms one above another, as many

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as are sufficient to hold and work so many Bellows as will blow a Blast sufficient to drive the Smoke out of the Battery; the Bellows to be placed with their Muzzels in the Center of the Room, with Ropes to go from the Levers that work them through the Arch or Floor into a Room below, where Men unfit for Arms, Women, great Boys, &c. are to pull at the Ropes and work the Bellows, all the Muzzels of the Bellows to have Valves in them, and be fix'd into one Tube in the Middle of the Room from which a Conduit of brick or stone should be made into the Middle of the Battery, (if the Distance between the Bellows and the Battery is something long it matters not) and proportionable Tube, or Conduits, to be branched to, and blow under the Breach of each Gun. I imagine two Bellows to each Gun in a close Case-matted Battery will be sufficient, but Experience is the best Instructor.

The Description of a Battery, according to Plans in Plate 6, *Fig. 1, 2, 3.*

In a dry Situation (I imagine the Capital of the Bastion a proper Place for those Batteries;) lay the Foundation as low as the Bottom of the Ditch, and to prevent, as much as possible, such Batteries being blown up by an Enemy, drive or place Piles quite round the Battery, a proper Distance from the Foundation, about six or nine Inches apart from each other; each Pile to be bored like a Pump, that the Miners Approach may be heard, and plainly discovered, and their Progress stop'd at the Piles, by putting Gunpowder down those Piles which the Miners have either cut or dug under, and Fire after it; or those pierced Piles may be close together and long iron Bars drop'd down to stop the Miners; for their Arrival at the Piles will be easily discovered, by listening at the Top of them. It appears to me, Miners will find it extremely difficulty to pass such

Piles if they are very deep in the Ground as their Galleries may, at all times, may be pierc'd from the Top through the Piles, and Gun-powder or suffocating Matter continually put down, and the Vent through the Piles stoped above ; nor can the Cannon or Bombs of an Enemy prevent this, for the Heads of the Piles may be any Depth under Ground, and arch'd over, not leaving sufficient Height for Miners to make Galleries over the Arch undiscovered, such Piles may in some other Respects be of Service in the Defence of the Place, as will be shown hereafter.

As this Battery will be a very great Weight, the Foundation must be broad, and very good, and built with Stone or Brick within about two Feet of the Height of the Rampire, or Terra-plain of the Bastion, to have a strong Pier for each Coin, and a smaller Pier in the Middle on each Side, and each Side to have two Openings arched, but not so high as the Surface of the Ground by six or seven Feet ; and a sufficient square Opening in the Middle from the Foundation to the Top, but arched over, and made Bomb-proof at the Height of the low Platform, under which Arch the Bellows are to work to blow the Smoke away ; this square Opening in the Middle to be thirty, or forty Feet square in *Fig. 1, 2, 3,* and open from the low Plat-forms upward, for the Smoke to go out.

When the Battery is raised within about two Feet of the Surface of the Ground, begin to build the outside of those Fronts, that Besiegers call place Guns to bear upon, with Blocks of Pebble Stones run together with Metal of old Guns, or any other cheap Sort of cast Iron ; these Blocks made of Iron and Pebbles, to be of a sufficient Thickness in the Wall, and well back'd with Masonry, and built to the Height of the Plat-forms on which the first Tier of Cannon are to be planted.

At

At the Height of these lower Plat-forms, begin to build the Outside of those Fronts of the Battery, which an Enemy can bring Cannon to bear direct upon, with solid cast Iron, sufficiently strong to resist and break the heaviest Cannon Balls ; the Iron is to be well back'd with Masonry between the Guns, which Masonry is to bear the Arches, but no Masonry is to be where the Muzzles of the Guns lie through ; the Thickness of the Iron is all the Guns Muzzles are to lie through, by this Means there need not be so much open Space between the Muzzling of the Gun, and the Embrasure, (or rather round Port-hole that holds the Gun's Muzzle) as to admit a Six-pound Ball : How the Guns are to be worked in this Sort of Battery will be shewn hereafter.

Having finished the low Battery, *Fig. 2.* and carried up the Piers that support the upper Battery, *Fig. 3.* whose Fronts are square on the Diagonal of the low Battery, see the Plans *Fig. 2* and *3. Plate VI.* this upper Battery to be the same in all Respects as the low Battery, only its Fronts are not so long as the Fronts of the low Battery.

The Fronts of the upper Battery being square with the Diagonals of the low Battery, give so great Advantage, that twelve Guns at least, will not only bear upon an Object, in any Part without the Works, but also will command a Breach in any Part of the Works, though there are only a Battery in every second Bastion. See the Batteries E and F *Plate VI.* in the Bastions G and H.

Of Guns, Gun-Carriages, and Plat-forms proper for the Improvements here proposed.

The Guns to be made with two additional Trunnions at the Extremity of the Breach, and a strong Pivot on the under Side of the Muzzle, projected

one Inch and an half below the Superfices of the Metal, to fit into a Place on the under or low Side of the Embrassure or Port-hole made for that Purpose, to hold the Muzzle of the Gun in the Middle of the Port-hole, when the Gun is moved Side-ways ; but the Muzzle of the Gun to be raised from this Hold when fired. This is all the Alteration I propose in the Guns, except it hereafter be found practicable, to make Guns to be loaded at the Breech, by a Contrivance proper for that Purpose.

The Gun-carriages to have fixed in them, strong purchasing Hand-screws, one under each Trunnion, and one under the Breech or Pammel, five in Number, to lay the Gun to shoot high or low at Pleasure, without raising or lowering the Muzzle ; by this Means, and by what follows concerning Plat-forms, the Out-side of Embrassures or Port-holes need be little bigger than to receive the Muzzle of the Gun, supposing the Embrassure or Port-hole to be made of Cast-iron or other strong Metal.

The Plat-forms to have a strong Plank circular Edgeways, to lie under the fore Wheels of the Gun-carriage, when the Gun is run out ; this Plank to lie flat upon proper Rolls, and make a Part of the Plat-form, so that these Rolls will easily run the Plank to either Side of the Plat-form, and carry the Gun with it, and traverse the Gun with little Trouble ; there may be another such Plank under the hind Wheels, but I think a Wheel may be contrived to be under the Middle of the hind Axle-tree to answer better.

By what is said above, it is easy to understand by the Methods here proposed, that the whole Body of the Gun is to be moved to give Direction to the Shots, this perhaps will appear preposterous, but I make no doubt if a Trial is made, according to the Method here proposed, the Difference of Time and Labour

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Labour in fighting Cannon by this or the Method now used will be found inconsiderable, for in Service where the Object is generally fix'd, the Direction of Guns doth not want much altering, but the Advantage of having Embrasures, that in a great Measure secures the Guns from being dismounted, and also covers the Men so effectually, that but few can be killed, being so very interesting will I hope induce some able Persons to promote the Design.

I have propos'd to build with large Pebble-stones, run together with the Metal of old Guns for cheapness; but small Pebble-stones run together with Lead, I think in some Cases are preferable, as Splinters will rarely fly from this Material; nor will a Ball be reflected from it with so great a Force, as from cast Iron.

The Expence of the Materials here recommend- ed, will be different almost in every other Place; but in most Places where there is a Navigation from the Sea, the Expence will be something near the following Calculation.

It will take near one hundred and fifty Cube Feet of Lead and small Pebbles run together to make one Embrasure; every such Cube Foot will require near two hundred Weight of Lead * at fifteen Shillings a hundred Weight, by Supposition the Pebbles for one Embrasure may cost five Pounds in some Places; which together with twenty Pounds for Workmanship, and ten Pounds to make a Bomb-proof-arch over the Gun, amounts to two hundred and sixty Pounds.

It will take near one hundred Cube Feet of cast Iron to make one Embrasure; a Cube Foot of cast Iron weighs upwards or about four hundred Pounds Averdupoise, a course sort of cast Iron and old Guns, &c. may be had in England, for about eight or

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* In many places the Lead only cost 14 s. an Hundred Weight.

nine Shillings at most, the hundred Weight Freight included; one hundred Cube Feet of which will cost, at eight shillings the hundred Weight, one hundred and sixty Pounds; which with twenty Pounds for Workmanship, and ten Pounds to make a Bomb-proof-arch over the Gun, amounts to one hundred and ninety Pounds: If proper Pieces of cast Iron for Building can be conveniently form'd from the smelting Furnace will save much Expence.

If Pebbles run together with cast Iron will answer the End proposed, one hundred and fifty Cube Feet of this Material, will much secure the Men and Gun; about one hundred and half of cast Iron will (strongly) run a Cube Foot of Pebbles together; the Expence of which for the whole Embrasure is ninety Pounds, which with twenty Pounds for Workmanship, and ten Pounds to make a Bomb-proof-arch over the Gun, and five Pounds for the Pebbles, amounts to one hundred and twenty-five Pounds,

In the above Estimate, I do not mean that the Pebbles are to be run together no larger than Foot Cubes; on the contrary, I would have the smallest Piece in the Work sixty hundred, and upwards to four, six, and eight Tuns in one Piece; the Front of these Embrasures to be stop'd about forty-five Degrees, that Balls may glance freely off.

Tho' these Embrasures are very expensive, (it appears to me) they will be of a signal Advantage, especially in Places of Consequence; for it is easy to conceive that the Fire of strong Batteries, whose Guns it is next to impossible to dismount, or destroy the Men that fight them, will greatly retard the Siege, and to besiege any considerable Town will cost at least two thousand Pounds every Day the Siege continues, (including the Army's pay) according to the Accounts of those experienced in Sieges, and by lengthening the Siege a few Days, a Place is sometimes

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sometimes saved; if not, a few Days will cost the Enemy, as much more to take the Place, as the Batteries that lengthened the Siege cost building.

The above Expenditure of a Siege is coarsely taken from Marshal *Vauban's* Account, of Stores required for a Month's Siege, as inserted in Mr. *John Muller's* Attack and Defence, *Viz.*

Stores required for a Month's Siege.

Powder as the Garrison is more	} 8 or 900,000lb.
or less strong - - - -	
Shot for Battering Pieces - - -	6,000
Shot of a lesser Sort - - - -	20,000
Battering Cannon - - - -	80
Cannon of a lesser Sort - - - -	40
Small Field Pieces for defending the Lines -	20
Mortars for throwing Shells - - -	24
Ditto for throwing Stones - - - -	24
Shells for Mortars - - - -	15 or 16,000
Hand Granadoes - - - -	40,000
Lead Bullets - - - -	180,000
Matches - - - -	10,000 Brace
Flints for Muskets best Sort - - -	100,000
Plat-forms compleat for Guns - - -	100
Plat-forms for Mortars - - - -	60
Spare Carriages for Guns - - - -	60
Spare Mortar Beds - - - -	30
Spare Sponges, Rammers, and Ladles - - -	20 Sets
Tools to work in Trenches - - - -	40,000

Several Hand Jacks, Gins, Sling Carts, Traveling Forges, and other Engines proper to raise and carry heavy Burdens; as likewise some to carry Water to extinguish Fire; several Parcels of spare Timber for Bridges, Wheel Wrights, Carpenters, &c.

There are besides several other Things necessary, as Miners Tools, Mantelets, stuffed Gabions, Pickets, and Gabions in great Quantities, Tools for Smiths, Carpenters, and Wheel Wrights, a Number

ber of Horses for the Artillery ; Carts and Waggon's such as can be procured in the Country are also used upon Occasion ; I think the Defence of the Covert-Way may be greatly encreased by the different Method shown in *Plate VI.* but as that Scale is too small to show the Method clearly, see *Plate VII.*

By *Plate VI.* it appears that the Bastions that have the Capital Batteries in them, are more easily mastered than the Bastion between them, that has no Batteries in it but the Flanks, for the Besiegers cannot erect any Battery to make a Breach in the Bastion L, but twelve Guns at least will bear upon it from the Batteries in the Bastions G and H, which twelve Guns will do more Execution against the Enemy's Batteries, than any Number of the Besiegers Guns can do against the Batteries E F, whose Guns also commands the Bastion L so greatly, that it is almost impossible to take it and make Lodgments there ; but if the Bastion G is attacked, the Battery F, in the Bastion H is too far off to do any great Execution, against the Batteries the Besiegers will raise to make a Breach in the Bastion G, and the Battery in the Bastion opposite the Bastion L, on the other side of the Town, is also too far off, and the Height of the Works will prevent those distant Batteries from seeing the Enemy's Batteries, tho' the upper Tier of Guns in the capital Batteries are designed to be about fifteen Feet higher than the Parapet : Therefore hollow Piles must be driven and counter Guards, and Mines made before the Bastions that has the Batteries in them, to make those Bastion as hard to take as Bastion L ; but if the Place is of so great Importance, that the Expence of making such a Battery in each Bastion as is here proposed can be complied with, and hollow Piles made a proper Use of, the Besiegers Batteries, and Mines, will meet so great Obstructions, that it will be next

to

to impossible to take the Place, without a much greater Expence than the Place is worth, and,

Supposing a watery Situation, where the Besiegers cannot make Galleries under the Ditch, nor dismount the Guns in the capital Batteries; I think in this Case, it will be impossible to make a Passage over the Ditch; for, in my Opinion, no Man will attempt to make a Passage over a Ditch against the Fire of at least eighteen large Cannon; and admit a Passage is completed a cross a Ditch, at the Expence of the Lives of ten or fifteen thousand Men, and a Breach made in the Rampier by Mines; for I imagine the capital Batteries will not suffer the Besiegers Cannon to make a Breach. There will be twelve, or eighteen large Cannon to fire into the Breach; and and if (notwithstanding all this Defence) the Besiegers make their Way through the Breach, they will be stop'd upon the Rampier, in the Middle of a Fire from twenty-four or thirty Cannon, (if there is a Battery in each Bastion, and twelve or fifteen having only Batteries in each other Bastion; according to Plate 6,) by a Wall of Masonry built on the inside, at a proper Distance from the Rampier, and a deep narrow Ditch faced with Masonry, with hollow Piles drove it its Bottom if the Ditch is dry, to hinder the Miners making a Gallery through the Rampier, and under the Wall, to blow it up; this Wall and Ditch will at least give the Place an Opportunity to capitulate at last; for the Fire of the capital Batteries will prevent Lodgments being made by an Enemy, either in the Bastions or on the Rampier.

See the Wall and Ditch mark'd M *Fig. 4. Plate VI.*

The Piles need not be driven in the Bottom of this Ditch till after it is known what Front will be attack'd; and if the Ground is not Sand nor Gravel, the Piles need not be driven much above seven or eight Feet below the Bottom of the Ditch, for the Ground

Ground being strong Earth, Loom, or Clay, may be bored through the Piles, to a sufficient Depth for discovering the Approach of the Miners piercing their Galleries, &c.

It is presumed the Rampier of most Places have a Slope on the Inside, near equal to the Height of the Rampier, which Slope I would take away, and make a Wall of Masonry, to gain more Room for the Ditch, and Wall, M. Plate 6. before mentioned.

There are sufficient Room against, and partly in the Gorge of each Bastion, which is at every Corner of this Wall and Ditch, mark'd M. Plate 6. (which Wall and Ditch, may be call'd the capitulating Defence,) to make Places for Musquetry and Cannon, if necessary for the Defence of the Wall and Ditch, sufficient to oblige the Besiegers to make a Breach in the Wall by Cannon or Mines, either of which will be attended with a good deal of Difficulty, and Danger; the Wall being defended from Cannon by the Height and Thickness of the Rampier; and, the Walls own Defence, joined with the Defence of the capital Batteries, will make an Escalade dangerous, and imprudent, and if it is a dry Situation where Galleries can be made under the Ditches, the hollow Piles in the Bottom of the Ditches made a proper Use of, will much retard making Mines under the Ditches, Rampier, or inside Wall, if not wholly prevent their effect.

Objection. A Breach may be made in this Wall, with the same Battery that make a Breach in the Rampier, and the Rubbish will fill up the narrow Ditch between this Wall and the Rampire.

Answer. If so, the Breach must be made in the Courtain contrary to Art, and as this Wall may be lower than the Rampier, it will require much Time to make a Breach, so low in the Rampier as to come at the Wall; besides the capital Batteries will all the

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Time do much Execution, against the Besiegers Batteries; as to the Rubbish (filling up the Ditch,) it may be taken away as fast as it comes in, for nothing can disturb the Besieged in this Work, but Shells and Stones, both of which are very uncertain in hitting such a narrow Place as this Ditch will be.

This interior Ditch and Wall, may be of greater Defence than is yet imagin'd, by all that is said; for the small arch'd inner Bastions mark'd O, at the Corners, may very conveniently be open towards the Place, Bomb-proof, and sunk low; for the Ditch is designed to be very deep at the Gorge of each Bastion, and the Bottom of the Ditch rise towards the Middle, and the small inner Bastions-Tops or Terra-plain are to rise towards the Middle, so that the Cannon planted below, will graze along the Bottom of the Ditch, and the Top of the next smaller inner Bastion half way over it, and the Musquetry and small Cannon planted in Bomb-proof Places, above these Cannon that are planted at the Bottom of the Ditch; will also defend the Faces, and Tops of the small inner Bastions, mark'd O; P Stairs down to an under ground Communication Q, where the Ditch is dry.

R E C A P I T U L A T I O N.

ALL the additional Strength here proposed to Places fortified according to the present Methods of Fortifying, depend chiefly upon making Batteries in a Fortification, whose Fires cannot be silenced by the numerous Batteries of Besiegers; and as the weaker Material cannot perpetually resist the Strokes of the Stronger, a Battery must be made of a Material equal in Strength to Cannon Balls, to effectually resist their Force; for this Reason, I have chose cast Iron to build those Fronts of the Batteries, against

against which an Enemy can bring a great Number of Guns to bear direct ; and those Fronts which an Enemy can only batter in an oblique Direction, to be built with Pebbles run together with cast Iron ; which will resist oblique battering a Time sufficient to tire Besiegers ; and by giving the Fronts of those Batteries a great Slope, (about 45 Degrees ;) Pebbles run together with cast Iron may be sufficient, to resist any Battering, and will be much cheaper than solid cast Iron, only having the Holes in which the Guns Muzzles lie to fire through, of strong solid Metal.

The Muzzles of the Cannon in these Batteries, are to lie nearly fair with the Face of the metal Wall, so the Besiegers cannot dismount them nor kill any Man in the Battery, excepting a direct Shot hitting the Face of the Muzzle can dismount a Gun ; which being admitted, yet the Difficulty of hitting so small an Object is so great, but few Guns will be dismounted in that Manner ; and the Enemy's Guns and Batteries will suffer greatly all the Time, and I cannot conceive it possible for the Besiegers to bring sufficient Metal Batteries to a Siege ; therefore a Place defended by a few such Batteries, as are here proposed, will have great Advantages over the Besiegers Batteries and Approaches.

These Metal Batteries can only be destroyed by Mines, and that only when in a dry Situation ; but if proper practicable Means are made Use of, to obstruct the Enemy Miners, it will be next to impossible they can be blow'd up ; for as these Batteries are of a small Extent, they may be well guarded with Mines, and Galleries ; which hollow Mines and Galleries, being properly guarded with hollow Piles, in the Manner already described, will give an Enemy almost endless Trouble to get under the Batteries.

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The greatest Objection I can conceive against Metal Batteries in a Fortification, (the Expence expected) is the Mischief Balls will do by rebounding, which in a large Place may prove considerable; but in Places of a middle Extent, Balls generally will fly clear of all, as the Cannon must be planted very near if they hope to do any Execution, and consequently the Balls will strike the Slope of the Battery very strongly, with an upward Direction, so as to rebound over the highest Buildings in a Place of midling Extent.

It the metal Batteries according to the Plans 1. 2. 3. *Plate VI*, are too expensive for Places of common Importance, Batteries of Metal less expensive, may be made that will add considerably towards rendering the Advantages of Fortification equal to those of the Attack.

I would make these Batteries circular, with Gun-ports about nine Feet asunder, that more Guns may bear to an Object, and every second Gun to be prepared and fired, while the next Gun on each Side (being run in by the Recoyle in firing) are loading, by this Method almost a constant Fire may be kept up, and near double the Number of Guns will bear upon an Object (and half fire at a time) as can be brought to bear upon an Object, through a thick Parapet, where there are but one Gun in every seventeen or eighteen Feet length of Parapet; and that the Guns may recoyle furthe to give Room, the Plat-forms may be laid level, or if need be instead of the Platforms Ends toward which the Gun recoyls, being higher than the other End, they may be lower if Necessary.

If a Place is of no great Importance, and of a small Extent, one circular metal top'd Battery raised in the Centre of the Town, to fire (on every Side) over the * Tops of the Buildings, will considerably annoy

* Where a Battery of this kind is, the Buildings next the Rampiers must be low.

annoy the Besiegers; while at some considerable Distance beyond the Works; the excessive Height of this Battery, with Guns the Enemy cannot dismount, (till they have battered away the solid Masonry below the Metal Top, so as to throw it down; but this will both require much Time, and cost the Enemy † dear, if the Battery is built as it should be,) will be a great Annoyance to the Besiegers Batteries, and will well defend a Breach on any Side of the Town; the many Rooms under this Battery, being Bomb-proof, will be exceeding useful; nor need this Battery have any Bastions to defend it when the Town is taken, nor cover more Ground than is necessary to support the Superstructure‡, if in a wet Situation, and yet be defenceable to hold out a considerable Time after the Town is taken, as the new Method of fortifying contained in the next two Chapters will show; see Fig. 10. Plate VIII.

C H A P. III.

EXPLANATION of Fig. 1. Plate VII.

A new Method to fortify a Re-entering Angle.

AA The Ditch at the Foot of the Escarpe.

BA The sloping Height of the Body of the Place.

CD

† This Battery will much annoy the Besiegers in their Approches, and ruin their Batteries till they get near the Body of the Place, and are covered by the Works of the Town.

‡ If the Situation is dry, the Bottom of this Battery, being of a small Extent, may be well secured with Mines, and hollow Piles, at a little Expend; and the Bottom being very thick of solid Masonry, with a great Thickness of Earth round it, will require a very considerable Time to make a sufficient Breach with Cannon.

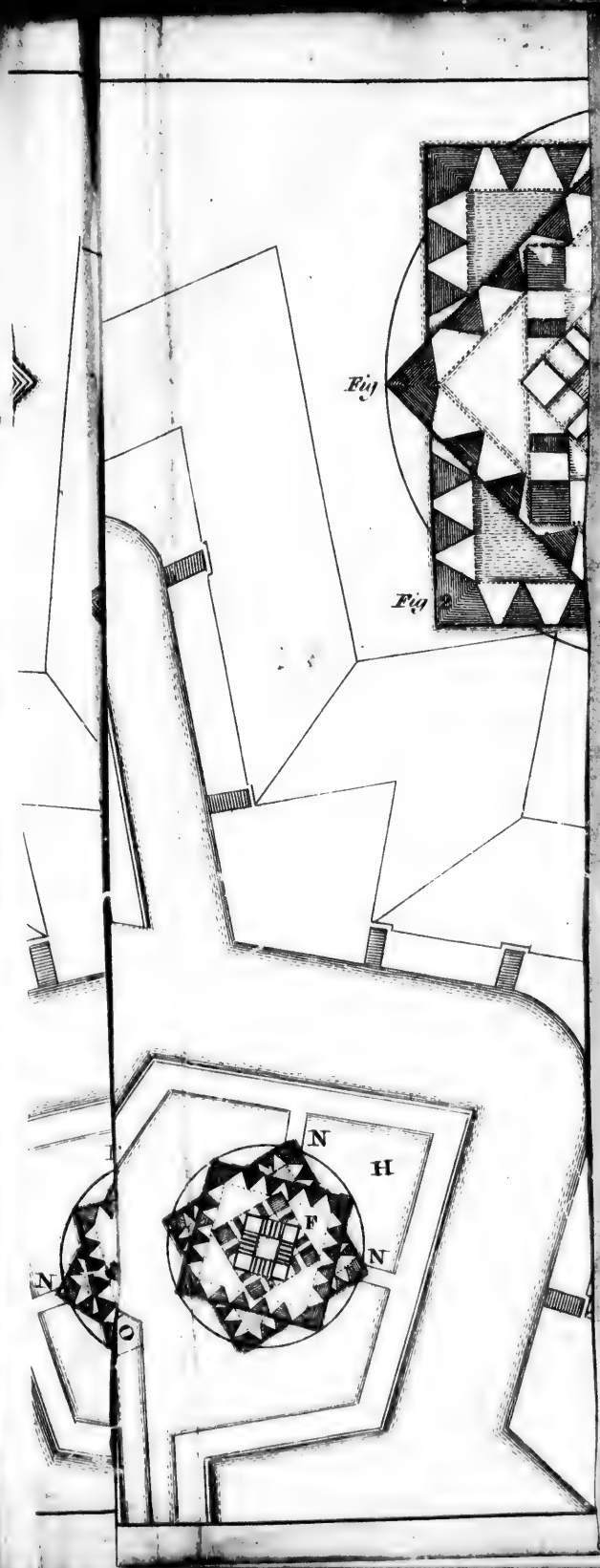
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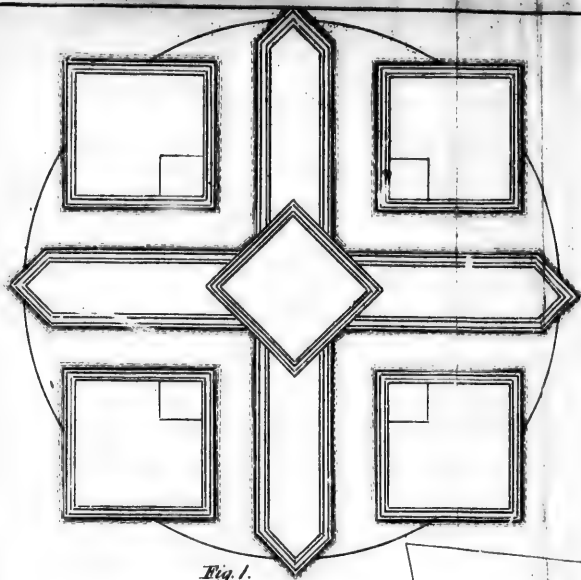


Fig. 1.

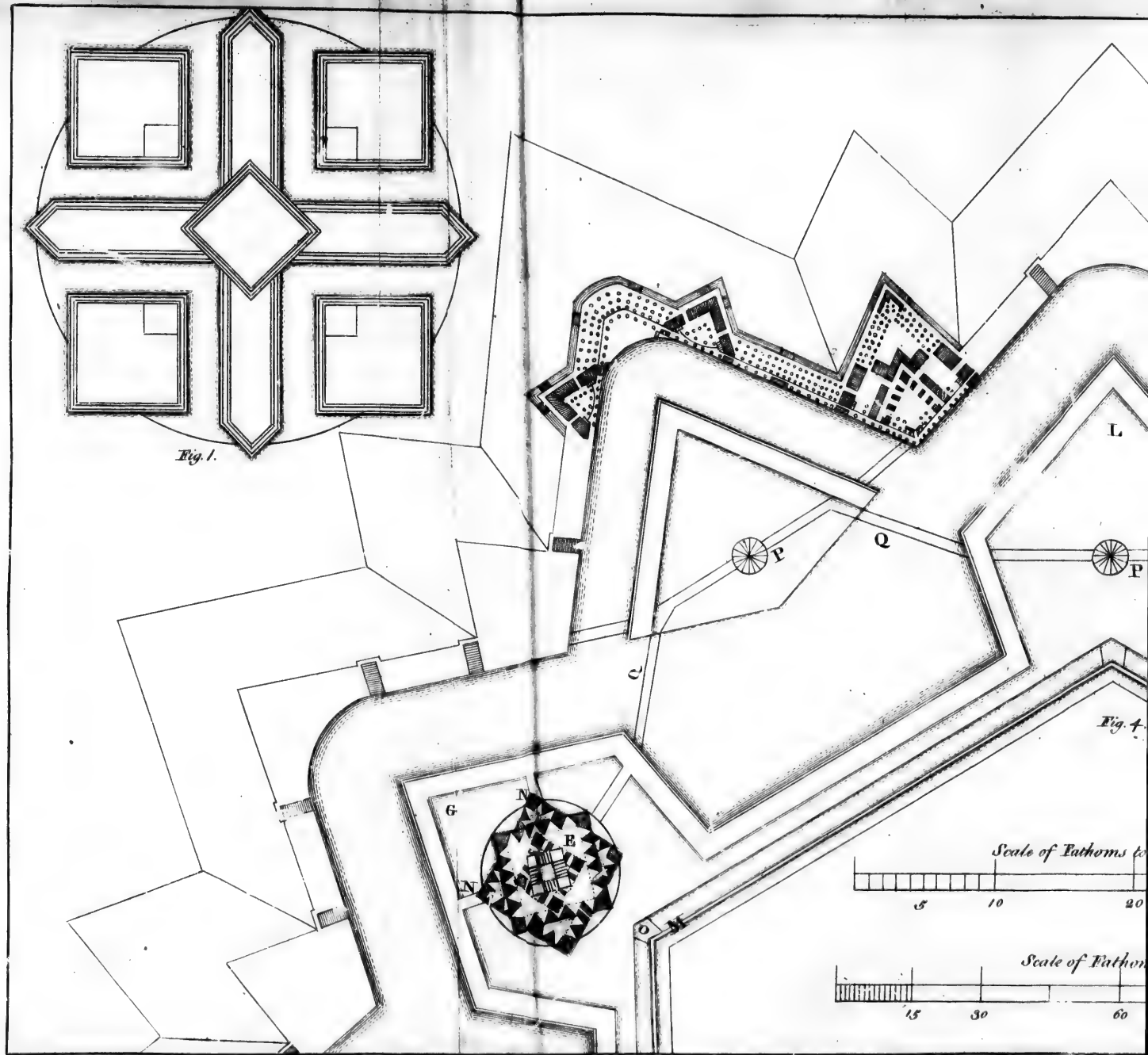


Fig. 4

Scale of Fathoms to

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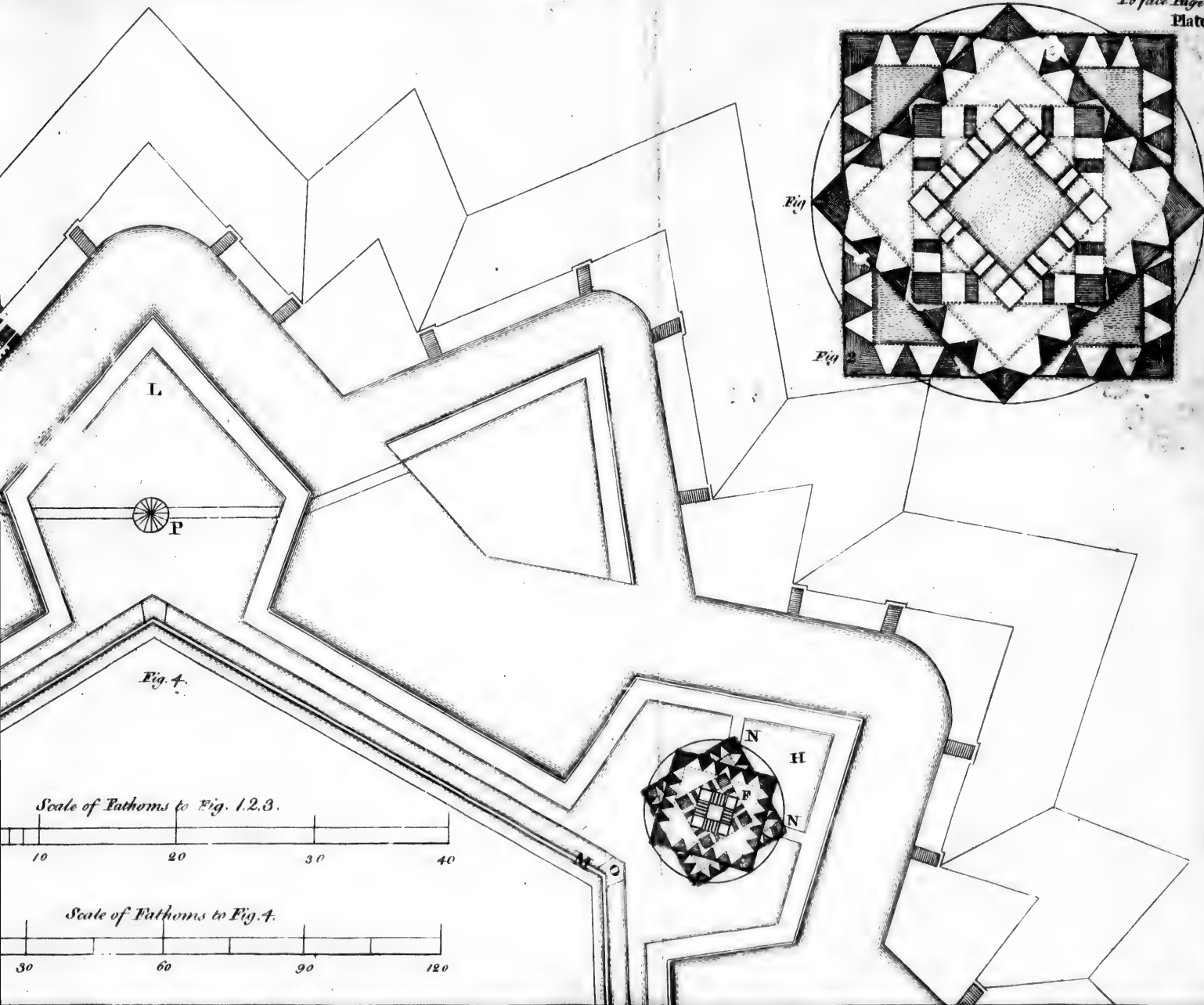
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Scale of Fathom

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Y Pier

CD The Breadth of the Rampier, exclusive of the Slopes and Parapet.

E The inward Slope.

F. Traverses

G Places of Cannon and Mortars.

H Lodgments covered Bomb-proof.

II Passage round the Body of the Place.

KK Section through FGH.

L A Recess or Slope from MM equal to the Parapet q, where at L is an Opening up behind the Parapet for to fire Musquets or Pistols, or to throw Granadoes down to MM, or any Spot close along the Bottom of the Wall AA; and to a considerable Distance from the Wall into the Ditch.

NN The Profile of a new Method of Fortification.

O The Ditch.

P A Covert Way round the Foot of the Escarpe.

R Passages under the Rampart to S a secure Place for Musquetry to defend the Covert Ways, Ditch, &c.

7. 8. 9. 10. 11. Profile of the Covert Ways.

8. The great Covert Way.

9. Passage round the Covert Way at the Top of the Steps up which the Musquetry mount to fire.

10. 11. Earth to secure the Men from Shells, Stones &c.

13. A Gallery round the Place below the Covert-way,

EXPLANATION of Fig. 2.

A Method to make a Covert Way of greater Defense.

T A Stone or Brick Redoubt, in the Place of Arms.

UU Arches Boom-proof.

WW A clear Passage, quite round under the Arches UU.

X A Ditch ending at the Traverses ZZ.

Y Piers of Brick, or Stone, over which a Platform

H

of

of Timber must be laid, to support a sufficient Thickness of Earth, in Time of a Siege.

Z Traverfes.

- 1 Passage round the great Covert-way.
- 2 Steps up, from under the timber Platform made Bomb-proof with Earth, to fire over, and upon the Glacis.
- 3 The great Covert-way.
- 4 The little Covert-way.
- 5 Passages through the Traverfes under Arches.
- 6 Stairs of Communication.

As all, or as many as possible of the Cannon, which can play upon the Glacis are generally silenced, before the Besiegers attempt to make Lodgements on the Covert-way, or plant Batteries upon the Ridge of the Glacis; and Batteries on the Right and Left of the Attack, can play upon the Top of the Parapet of the Body of the Place, and Ravelin, and lessen the Fire of the Musquetry, all the while the Besiegers are raising Batteries, upon the Ridge of the Glacis; so that the Flanks are almost the only Defence the Besiegers have left; (after the Outworks are taken) whose Defence can annoy the Besiegers but very little upon the Ridge of the Glacis, or on the Covert-way; so that Places generally capitulate soon after the Besiegers are Masters of the Covert-way, and have begun to batter in Breach; for the numerous Batteries of the Besiegers, having in a great Measure silenced the Besieged's Fire, the making Breaches, and crossing the Ditch, have seldom met with many Difficulties of late, but what were easily surmounted, by the superiour Strength of the Besiegers; therefore, to render Fortification in this, and other Respects, more equal to the Attack, the Profile 7, 8, 9, 13, *Fig. 1*, and the Plan *Fig. 2*, *Plate 7*, shews that a Covert-way may be made of so great a Defence, without augmenting the

Garrison

Garrison as to cost the Besiegers more than double the hitherto common Expence of taking Covert-ways.

REMARKS on *Fig. 1* and *2, Plate VII.*

It appears to me the Troops cannot be drove out of this new Covert-Way, *Fig. 2, Plate VII.*, by Sword in Hand only, let the Besiegers be ever so strong, without losing five Hundred Men, or more, for every Hundred that defends the Covert-Way ; as I think will appear to any one who understands Attack and Defence, by inspecting *Plate VII.*

Nor can they be drove out of this Covert-Way by Shells and Stones, till all, or the greatest Part of the Platform covered with six or seven Feet Thickness of Earth, 10, 11, *Fig. 1.*, are beat down by Bombs ; which will cost the Besiegers much Time, as many of their Bombs will miss the Parapet ; it being too nice a Point to throw every Bomb to a certain Length, or always within twenty or forty Feet of a certain Length.

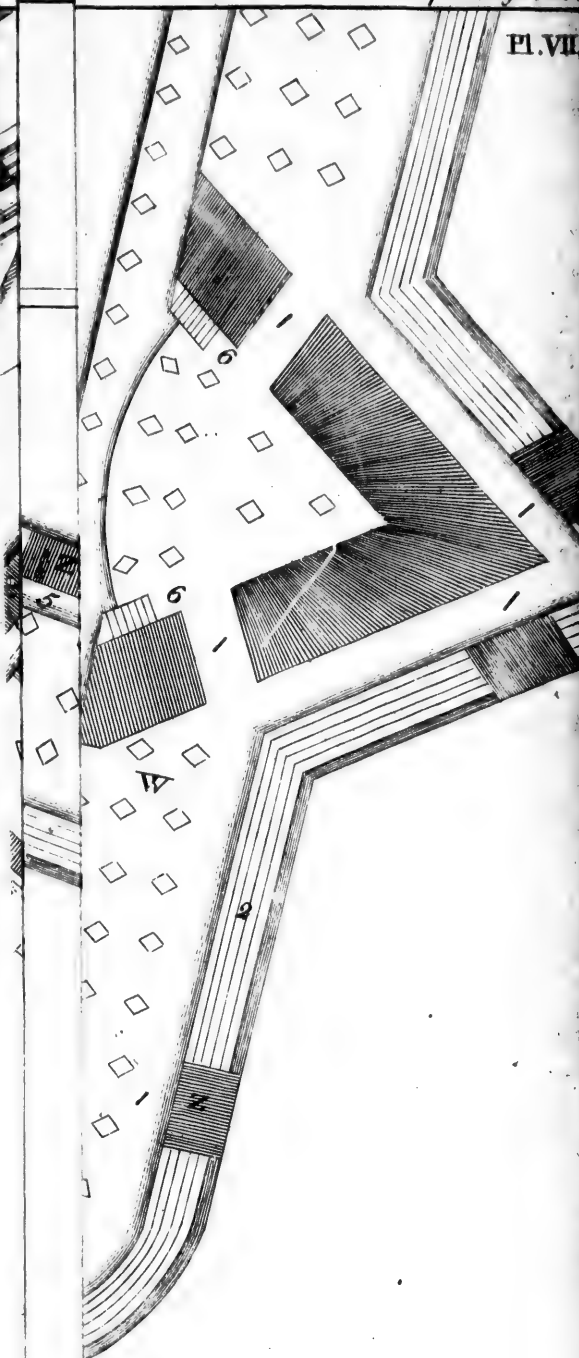
If the Besiegers attempt to take this Covert-Way by Mines, the Gallery 13, and a proper Use made of hollow Piles and stinking Matter (mentioned before) will enable the Besieged to greatly obstruct the Besieger's Mines ; and many Mines must be sprung before this Covert-Way, the whole Length of the Front attacked, is rendered Defenceless ; for a Breach alone in the Parapet N, will be of small Advantage to the Besiegers.

Neither can the Besiegers raise Batteries upon the Ridge of the Glacis, without much Loss, till the Covert-Way is in their Possession ; for notwithstanding the Besiegers may from a Sap, on the Ridge of the Glacis N, ply the great Covert-Way 8, 9, with Granadoes so as to drive the Troops out of it, for a time ; the Troops in the little Covert-Way 7, will prevent the Besiegers from making Lodgements in the great Covert-Way, till both the Covert-Ways are taken, as will appear hereafter ; and Troops

placed at 12, will do much Execution in Case of an Enemy's March upon the Glacis, to attack the Covert-Way before the Parapet 11 is destroyed; and the Musquetry at S and P will also do much Execution on the Covert-Ways, and prevent the Besiegers making Lodgements there, even supposing the Troops are drove out of both the Covert-Ways, to do which will cost the Besiegers dear; for till the Parapet 11 on the Covert-Way is destroyed, the Defence at *S cannot well be ruined, it being Bomb Proof above, and covered from Cannon by the Parapet 11; the Covert-Way P at the Bottom of the Escarpe will likewise help to defend these Covert-Ways; so there must be four Defences destroyed before the Enemy can maintain their Ground on the Covert-Way; and as two of those Defences cannot be silenced, till the Parapet 11 is thrown down, and Batteries raised upon the Ridge of the Glacis, those two Defences will be a considerable Obstruction to the Besiegers, all the Time they are raising Batteries on the Ridge of the Glacis to silence them; and by inspecting *Fig. 1.* it is evident the Covert-way can not be taken till the Defences P and S are ruined, which cannot well be done (as I said before) till the greatest Part of the Parapet 11 is thrown down; and Parapet 11 may be made so large a Body of Earth, as to cost the Besiegers much Time to destroy it, even in a dry Situation where Mines can be made; but if there is Water to fill the Ditch, so that Mines cannot be made, such a Parapet will very much retard the Siege.

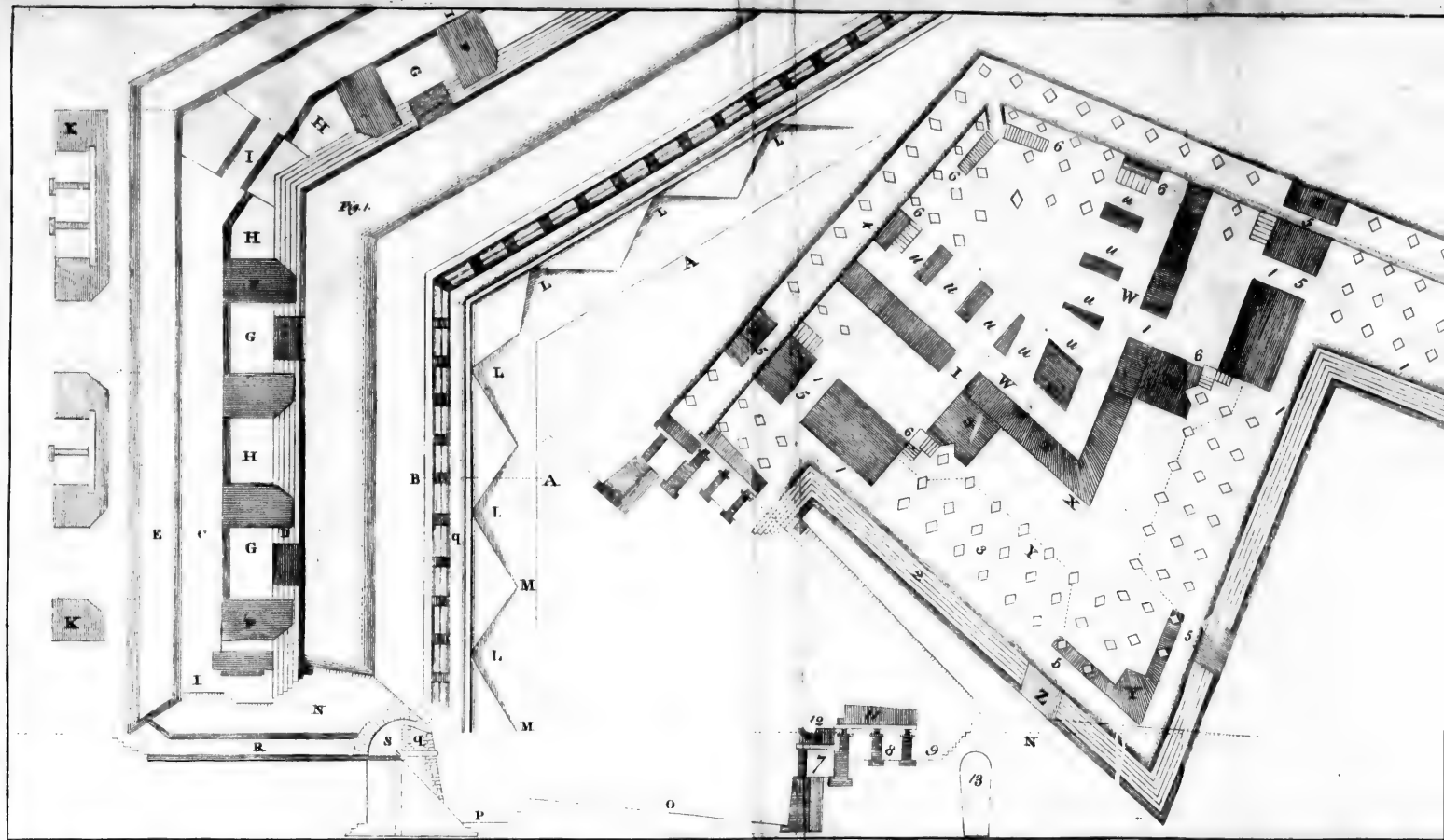
The *Plates VI and VII* being well understood, it (in my Opinion) will appear that Ricochets and Stones will have but little Effect upon the additional new

* The Defence at S is nearly answering the Defence of a Fausse Bray, but is not liable to be enfiladed; nor are the Troops placed there, liable to be drove out by Shells and Stones, as in a Fausse Bray.

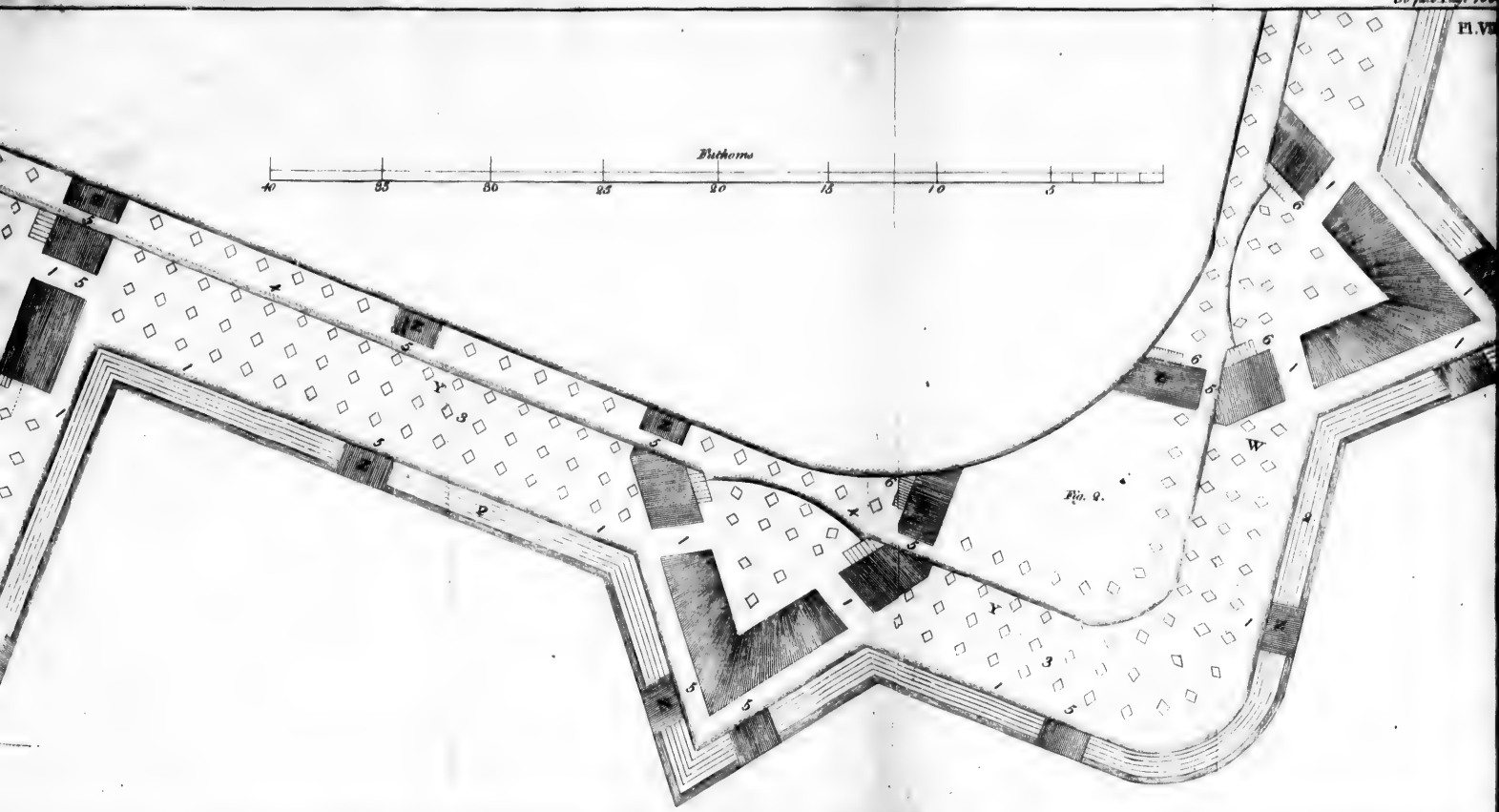
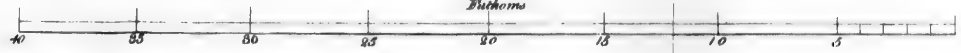


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new Works; Shells and Cannons will in Time destroy these Defences, and the strongest Works cannot resist Mines properly made, yet notwithstanding which, it appears to me the Methods here proposed to strengthen Places already fortified, are not wholly chimerical.

CH A P. IV.

EXPLANATION of PLATE 8.

IN this Plate is shown how a Circle may be fortified, which I think is an entire new Invention, *Fig. 1.* The Plan, and *Fig. 2.* The Profile, which being connected by dotted Lines, their Relation are easily understood, and *Fig. 2.* (The Profile) being explained, *Fig. 1.* (the Plan) need little explaining.

Fig. 2. A. The Glacis.

B. The great Ditch.

C Musquetoon, Pistol, and Granadoe Defence; for the Foot of the Scarp, and Bottom of the Ditch.

D Passage under the Rampier to C.

E The Entrance into the round Lodgings, G. *Fig. 1.*

F Store Rooms, and Bomb-proof Lodgings, for Men, also a Passage round the Place under cover Bomb-proof.

G. *Fig. 2.* Bomb-proof Places quite round under F.

H The Ditch round the Keep or Castle.

I A wide Place to give Light to the Windows of the Keep or Castle, (there are to be no Windows on the Outside in the Time of a Siege,) and to give Light also to the Stair-case.

M The Stair-case.

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N The Mettle-top, a strong Battery of Cannon, Bomb-proof, and open behind.

O Where strong Beams are to be laid, and cover'd with a sufficient Thickness of Earth, when the Place is besieged.

Fig. 3. The Elevation from the Cordon downward of the Musquettoon, Pistol, and Granadoe Defence, to a Quarter of the Keep, A A *Fig. 1.*

Fig. 4. The Elevation of the Line B B *Fig. 1.* where are Store-rooms, and Lodgings for Men, and a Passage round the Place Bomb-proof.

Fig. 5. Elevation of the Line CC shewing the Entrances of the Passages that leads to the Musquettoon, Pistol, and Granadoe Defence C, for the Foot of the Scarp, and Bottom of the Ditch.

Fig. 6. Elevation of the Scarp.

Fig. 7. A Plan, or rather Section of the Musquettoon, Pistol, and Granadoe Defence at the dotted Line in *Fig. 6.* shewing the Length, and Depth of the Recesses at that Place.

Fig. 8. Plan of the Musquettoon, &c. Defence, at the Cordon EE in *Fig. 6.*

The Seat of the Parapet covers the small Openings FF so far as the black Line GG, so that a small Part of the Openings FF are within the Parapet; where Musquettoons, Pistols, &c. are fired down, and Hand Granadoes thrown down upon the Enemy at the Foot of the Scarp and Bottom of the Ditch.

Figures, 9, 10, 11, 12, are Copies of *Figures 2, 3, 6,* Plate 8, by a larger Scale; which shews the Parts more distinctly; therefore the *Figures 9, 10, 11, 12,* being explained, the *Figures 2, 3, 6,* are also explained.

Plate 8. As *Figure 9,* and *Fig. 10,* are a Copy of Profile, I explain *Fig. 2,* by explaining *Fig. 9,* and 10.

EXPLA-

EXPLANATION of *Fig. 9, and 10.*

- PP The Glacis.
 QQ The Ditch and Covert-way.
 R The Recesses for the Musquetoon, Pistol, and Granadoe Defence.
 S Place for the Troops to defend the Foot of the Scarp, and the Ditch, with Musquettoons, Pistols, Granadoes, &c.
 T Passage under the Rampier into S.
 U Door into the Store-rooms mark'd G *Fig. 1.*
 W Store-rooms, and a Bomb-proof Passage round the Place.
 X Lodging-rooms and Store-rooms, quite round the Ditch, Bomb-proof.
 Y The Ditch.
 Z The Recess through which the Foot of the Castle and the Ditch are defended by Musquettoons, Pistols and Granadoes, &c.
 1 The Place to hold the Troops that are to defend the Ditch, and Foot of the Castle.
 2 A strong Battery of Cannon, defended by a metal Parapet; and the Outside of the Castle-top to be metal, five or six Feet below the Plat-forms.
 3 Strong Beams to be laid upon the Roof, and cover'd with Earth Bomb-proof, in Time of a Siege.
 4 An open Place to give Light into the Castle and Stair-case (there being no Windows in the Outside of the Castle in time of Danger.)
 5 A circular Stair-case.
 6 A Place for Mortars, Cannon, and Musquetry.
 7 A Passage under Ground, into the Ditch and Covert-way, Q.
 8 9 Galleries round the Place, with hollow Piles to stop the Enemies Mines.

EXPLANATION of *Fig. 11* and *12*.

AB A short Length of the Elevation of *Fig. 10* at Z.

CC The Foot of the Castle-wall, and also the Wall of *Fig. 9* at Q, defended down through DDD, from behind the Parapet EE.

FF The Top of the Parapet, wherein is an Arch behind quite round the Place to lodge Musqueteers.

GG Spaces through which the Musqueteers are to fire.

HH Strong Pieces of Metal well fixed, to support the Superstructure, and the Arch behind the Parapet EE.

Fig. 12. Is a short Length of the Elevation of *Fig. 9* at R, and is in all Respects in its Defence the same as *Fig. 11*, so the Explanation of *Fig. 11* is also an Explanation of *Fig. 12*.

The Method of building a Fort according to Plate 8, is so plain and easy by Inspection, that to give a Construction of it here, would be giving the Reader unnecessary Trouble.

REMARKS ON *Plate 8. Fig. 1, Fig. 9, and Fig. 10*.

The Plan this Fort is built upon, being a Circle the Ricochet Batteries are of little or no Service against it.

The metal Battery 2 *Fig. 10*, upon the Castle, seconded by the Cannon and Motars, that may be planted at G *Fig. 9*, will end it difficult for an Enemy to do much against the Place with Cannon; and as every Part is in a great Degree Bomb-proof, it will take a long Time to reduce the Place by Bombs only.

Figure 9, Is a very thick Parapet, it being eleven Fathoms thick, will cost a long Time to make a sufficient Breach, and Cannon planted at a Distance cannot fire upon this Parapet; the Direction of the

Glacis

Glacis PP being near two Fathoms higher, effectually covers it. The metal Battery is the only Object an Enemy can batter, till they advance their Batteries upon the Edge of the Ditch, to do this will cost them dear, as the metal Battery, and all the Mortars in the Place will incessantly play upon them, as also will the Cannon planted at G, as soon as they appear upon the Edge of the Ditch.

This Fortification being Bomb-proof in every Part, will greatly secure the Troops, and as the Besiegers in their Approaches cannot secure themselves so well from Bombs, as they do from Cannon, I would advise a good Number of Mortars, Cohorns, &c. in every fortified Place, when in Danger of being besieged.

If an Enemy attempt to take this Fort by Mining, the Galleries 8. 9, with hollow Piles made a proper Use of, will very much obstruct their Approach, and when the Galleries can no longer be defended, suffocating Smoke may be introduced to fill the Galleries, thro' Places prepared before for that Purpose, and so much stinking Smoke may be injected by Bellows, as to render it almost impossible for the Miners to proceed farther.

Admit the Miners by much Industry make a sufficient number of Openings to the Day, and by that Means, in some Degree, clear away the Smoke, and make Mines under Fig. 9. It will require some considerable Time to make secure Lodgments in Fig. 9, the Castle being so near, and capable of a good Defence.

If Plenty of Water is to be had (by Springs or otherwise) in the Castle, the Enemy, in Fig. 9 may be very much incommoded, by throwing Water into their Works, and make their Lodgments very uncomfortable, if not intolerable, especially in cold Weather.

As

As it is my Opinion, this Place cannot be taken by Escalade, I say nothing on that Head.

The metal-top'd Castle, *Fig. 10; Plate 8*, here spoken of, may well serve (with some small Alteration) for a grand Battery in the Middle of a Town, as spoken of in the End of the second Chapter.

EXPLANATION of *Fig. 1. Plate 9.*

The Side AB 328 Fathoms and a half, the longest Distance between the Defences CC, at each End of the Ditch L 133 Fathoms.

D The interior Slope.

E Terre-plain of the Rampier.

F Steps to raise the Musqueteers a sufficient Height to fire over the Parapet.

G The Top of the Parapet.

H Interior Slope.

I A little Ditch at the Foot of the Scarp.

K The Covert-way in the great Ditch.

L Glacis in the great Ditch.

M A narrow Covert-way,

N Broad Covert-Way.

O Steps up for the Musquetry to fire upon the Glacis.

P The Glacis.

Q A Second Glacis.

R The lower Tier of Guns in the metal Batteries, the Corners R arch'd Bomb-proof, and the Arches continued under the upper metal Battery S to the Opening T.

S The upper metal Battery raised above the metal R, See the Plans, *Fig. 1, 2, 3. in Plate 6.*

T A square Opening quite down to the Foundation; the whole Height consists of three Heights of Arches, the first Height of Arches being very high, will be two Heights of Rooms for to hold Bellows and People to blow away the Smoke: There may be many more Vents than the Opening T.

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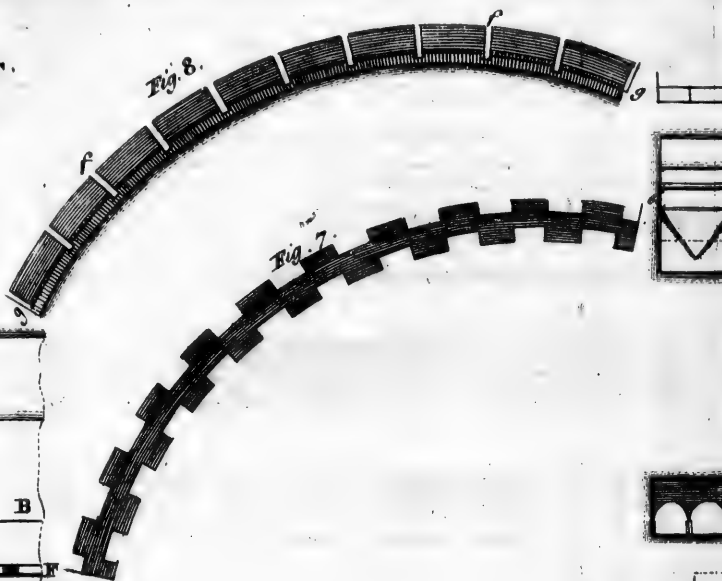
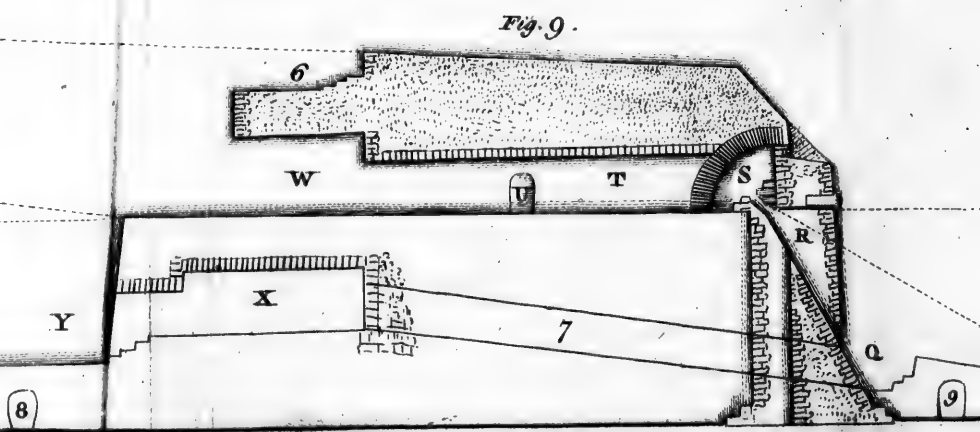
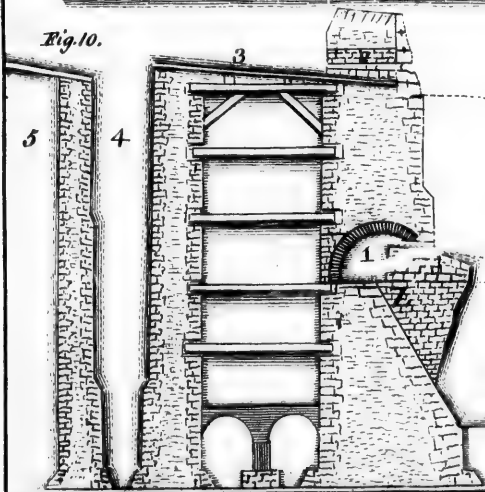
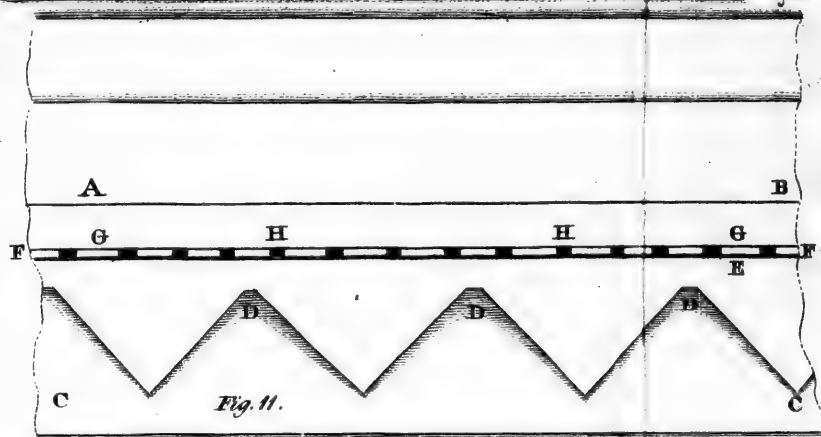
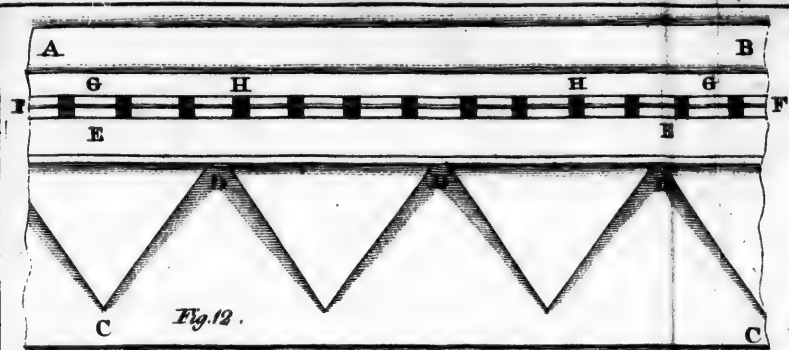
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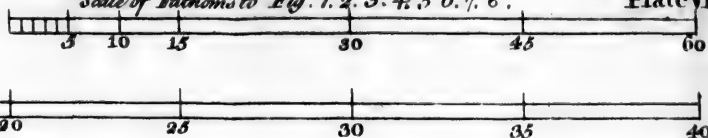
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Scale of Fathoms to Fig. 1. 2. 3. 4. 5 6. 7. 8.



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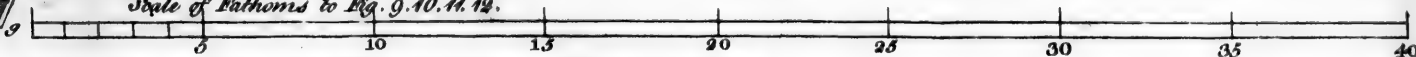


Fig. 6.



Fig. 5.



Fig. 4.



Fig. 3.

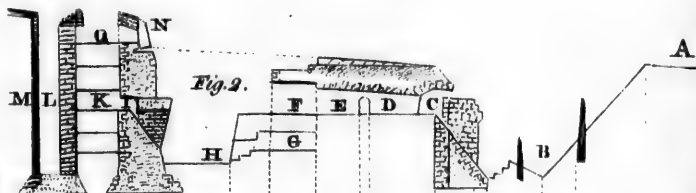
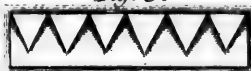
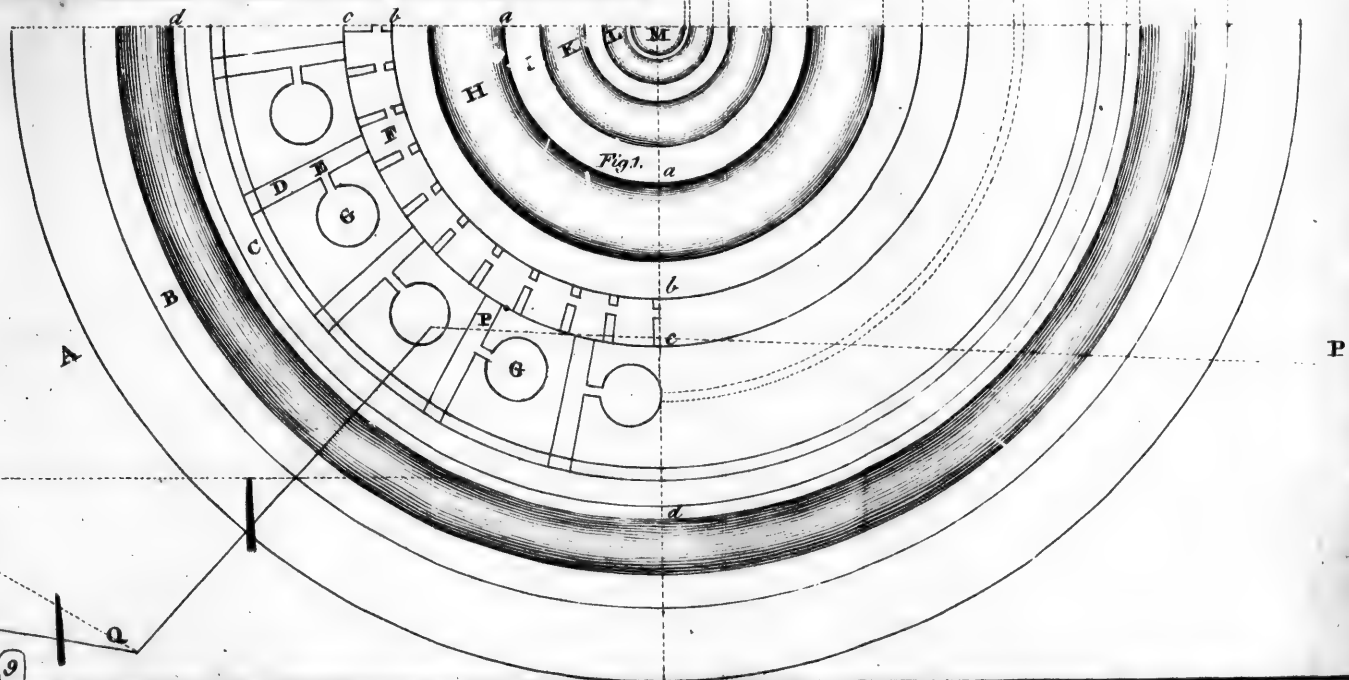


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EXPLANATION of *Fig. 2*, Plate 9.

Fig. 5. The Profile of *Fig. 2*, along the Line XY, Z a Covert-way, the same in all Respects as N in *Fig. 1*.

- a Where Troops are to lie to rest under Bomb-proof covering, while others are on Duty at z.
- b A small Redoubt to defend the Salient Angle.
- c A Glacis before the Redoubt.
- d Arches Bomb-proof to form a Terre-plain and Parapet for a Glacis.
- e Steps down to under-ground Communications with the great Ditch L, and to come out at f.
- f Doors in the Counter-scarpe to under-ground Passages into *Fig. 2*.
- g Traverses to cover the Troops from the Enfilades, while they defend *Fig. 2*.

The EXPLANATION of the Works cut by the Line, U. W. *Fig. 2*.

Fig. 4. Is the Profile along the Lines, U W by a larger Scale, therefore I will explain by the Profile, and the corresponding *Figures 1, 2, 3, &c.* in the Plans of the Works *Figure 1*, will make those Plans understood.

U The Coyne of the Scarp of the Body of the Place.

- 1 A Ditch at the Bottom of the Scarp.

The Space between 1 and 2, a Covert-way.

- 2 A Parapet to fire over to defend the Ditch 1, and the Foot of the Scarp, *Fig. 1*.

The Lines between 2 and 3 represents Steps, up which the Troops ascend to fire over the Parapet 2.

- 3 Is arch'd under and to be cover'd Bomb-proof.
 - 4 A deep narrow Ditch, into which the Shells will roll, that falls upon 3 and 5.
 - 5 A second Parapet. The Lines between 5 and 6 represents Steps, up which the Troops ascend from under the Covering 6 to defend the Ditch and Glacis L.
 - 6 Is arch'd under, and the Arches covered Bomb-proof.
 - 7 A deep narrow Ditch, into which the Shells will roll that fall upon 6 and 8.
 - 8 Is arch'd under, and the Arches covered Bomb-proof.
- The Space between 8 and 9, represents Steps, up which the Troops ascend to defend the opposite Part of the Covert-way.
- 9 A Parapet behind which Troops defend a Part of the Covert-way MN.
 - 10 A Part of the great Ditch and Glacis L.

It may be proper to mention, that the Works cut by the Line U h W, and mark'd c, defend the great Ditch and Glacis, i k, the same is to be understood of the Works under the metal Battery B.

I A Place to defend M, and prevent an Enemy being in Safety at M, in case Possession be got of that Place by underground Works; more need not be said by Way of Explanation, all the Works in this Plate being plain and easy to understand, (by any one who have but taken a little Trouble to qualify themselves for such Works) except the metal Batteries, and their Constructions may easily be understood, by any one who is a Judge of Buildings of this Sort; by carefully inspecting the Plans 1, 2, 3, Plate 6, and attending carefully to what is written in Chap. 2, concerning metal Batteries.

Fig. 3. A Profile a long the Line, p. q. Fig. 1.
RE-

REMARKS on *Plate 9.*

The detached Works *Fig. 2.* may be omitted, but as the principal Part of this Work is only a Covert-way, if the Parapet of Earth supported by Piers to cover the Troops from Shells, Stones, &c. are not made, the Expence of making such Works is inconsiderable, and they will considerably obstruct the Besiegers in approaching the Place, for,

The Besiegers cannot make a Parallel so near the Covert-way, by seventy or eighty Fathoms, till *Fig. 2* is taken, as they can if these Works are omitted, and, these Works give the Besieged an Advantage of sallying and retreating with the same Safety when the Enemy is two hundred and twenty Fathoms from the Covert-way, as they could have without those Works, when the Enemy is within one hundred and forty Fathoms of the Covert-way.

When the Besiegers are two hundred and twenty Fathoms from the Covert-way, they will be obliged to keep as strong a Guard in the Trenches, and Parallel, as, they need keep at the Distance of one hundred and forty Fathoms, if these Works are omitted, and consequently must from that Distance make their Works larger towards the Place, which will cost more Labour and Time.

The Communication is so safe and easy between the Body of the Place and *Fig. 2*, the Troops will well defend that Work; and the Redoubt being a safe Retreat under the Fire of the Batteries, A and B, and the small Arms in the Covert-way, &c. The Besiegers will suffer greatly if they attack *Fig. 2*, above Ground, and make Lodgments in it.

If the Besiegers pass by the detach'd Redoubt, *Fig. 2*, and make their Efforts between it and the metal Batteries A and B, the Besieged will have great Advantages over the Enemy, they being in Defences so near on each side the Besiegers Trenches, where the Besiegers have not sufficient Room to make Use of their superior Strength.

Fig. 1.

Fig. 1. The Length of the Front AB being † 328 Fathoms, is a greater Defence, and will cost more Labour to approach it, than a shorter Front; here is nothing in any Part between Fig. 2 and this Front, to afford the Besiegers any Cover, till they make it; so the whole Fire of the Front can fall upon any one Spot of the Glacis P beyond the Covert-way, and the Glacis L in the great Ditch; and the Works c and IC, will contain 140 Musqueteers at each Angle of the Square, to defend the Ditch; that is, 140 Musqueteers can fire all together for the Defence of each Front and Ditch; and, these Works are so well cover'd by the metal Batteries, and Covert-way, that they cannot be Enfiladed from any Part; and are in a great Measure secured from Bombs, see the Profile Fig. 4, Plate 9. The Utility of this new improved Covert-way is shown in the Remarks on Fig. 1 and 2, Plate 7, Chap. 3.

Some of the Advantages the metal Batteries will bring on the Side of fortified Places, are spoken of in explaining Plate 6, Chap. 2. Therefore I will only in this Place speak of them with Regard to their Situation in Fig. 1, Plate 9.

It appears by Fig 1, that a Square having such a Battery as A or B at each Angle, will be well defended by Cannon, and the Batteries will also well defend each other, and there is no Spot within the Reach of those Batteries but twelve Cannon, at least, can bear upon it; and as the upper Tier of Guns in these Batteries will be about fifteen or eighteen Feet higher, than the Parapet of the Place, will greatly annoy

† The Front should not much exceed 328 Fathoms, because the Ditch L will be too long between the Works C and IC, to be well defended by the Musquet; but if a Place is of so great Extent as to require a Square whose side is above 360 Fathoms, and under 700 Fathoms, Works may be made in the Middle of the Front for Musquetry to defend the Ditch.

annoy the Besiegers in their Trenches, and as six Guns at least and often eight or ten from each Battery, that cannot be dismounted, will bear upon the Enemy's Works; I do not conceive how the Besiegers can advance their Works so near as to take the Covert-way, against such a strong Cannonade as may be kept up by those Batteries.

It is easy to perceive that the Covert-way cannot be enfiladed, nor doth it need any Traverses, altho' it were a common Covert-way, the metal Batteries effectually covers both the Covert-way, and the small Arms that defends the Ditch from Ricochet firing.

I would have the Rampire of the Body of the Place arch'd behind the Parapet, like the Covert-way to secure the Troops from the Ricochets Shells, Stones, &c. but if it is not arch'd, the Ricochet Batteries that enfilades it, as there must be one on each side of the Place to enfilade the whole Length of the Front, it will be expos'd to the Fire of all the metal Batteries, which I think will be more than sufficient to silence all the Batteries the Besiegers can raise against the Place.

These metal Batteries are of a small Circumference, and may at a small Expencc be guarded well with Galleries, and Mines, and hollow Piles, and small Pipes laid when the Place is built, to fill the distant Galleries with suffocating Smoak, when necessary, and maintain them full; but these Pipes must be artfully laid, that the Enemy cannot easily find them to stop them up.

The Reader will easily observe here is a great Dependance upon the metal Batteries; it being taken for granted, the metal Batteries (being high and strong,) will so much obstruct the Enemy's Batteries, as to render their Cannon of little or no Effect against this Sort of Fortification, and reduce the Methods of Attack to Bombs, Mines, and the old Custom

Custom of Rolling-Banks, in a dry Situation; and in a wet Situation, to Bombs and Rolling-Banks only, and consequently render good Fortifications whose Ditches are full of Water, and cannot be drained dry, in a great Measure impregnable.

Tho' the Expence of metal Batteries will be very considerable, yet, when it is considered that few other Works need be made (except it be thought necessary to have Steccadoes to prevent the Town's being insulted or surprized in the Night, or a Rampier of Earth to defend the Buildings in the Town from Cannon;) it is not improbable but a Place may be fortified as cheap with metal Batteries, as with Masonry and Earth, especially where strong Fortifications are made.

With respect to the Number of Troops to defend a Fortification according to *Plate IX*. As there are only four Sides or Fronts to defend 4800 Men, I think, is a good and sufficient Garrison for a Place so fortified; and there is about as much Ground contained within this Square, as is within *M. Vauban's* Hexagon, whose Side is 180* Toises; and as an Hexagon has six Sides to be defended, and every Side of no easier Defence than the Side A B, *Fig. 1, Plate IX*, it appears the Hexagon should have a Garrison of above 6000 Men, to defend it as well as *Fig. 1. Plate IX*, can be defended by 4800 Men. And whither a Hexagon of the present Fortification, with a Garrison of 6000 Men, can make so good a Defence as a Square fortified according to *Plate IX*, with a Garrison of 4800 Men, I leave to the Judgment of Engineers who are well acquainted with the Methods of attacking and defending Places.

It being at present universally believed, that nothing can be built with a tolerable Expence to defend

* A Toise contains 6 French Feet; and a French Foot is to the English Foot as 16 to 15, nearly.

a Place, but Cannon will beat it down; therefore it may be proper to give a more particular Account of my Ideas, relating to the Construction of Batteries, that cannot be beat down by Cannon nor Bombs.

A few Experiments are necessary to fix the Thickness of cast Iron, and Pebbles run together with cast Iron, &c. sufficient to long resist, and break the heaviest Balls, but not having an Opportunity to make such Experiments, and altho' no Theory that I know of gives any Light to this Case, I will take it as a Thing certain, that less than thirty Inches thickness of cast Iron, will long resist and break the heaviest Balls.

That Cannon-Balls will break, is beyond Dispute with me, I having seen two Pounds and half Balls fly in Pieces, when thrown by a Man upon a smooth fix'd large Pebble Stone.

There are several Ways to use Stone and Metal in making Batteries, whose Guns will be made the more difficult to dismount, according to the Importance of the Place, and the Expence thought proper to bestow upon it.

There are large Stones of the Pebble Kind, in many Places where I have been, that will make very strong Batteries; they are indeed very hard to work, but a Machine may be made that will work them tolerably cheap. This Sort of Stone will not fly in Splinters near so much as the Stone commonly used in making Batteries; and it is by much the strongest Stone I know (and I have dealt with Stones this Thirty Years last past,) and when in a large Body, not many Degrees weaker than cast Iron; and will stand longer against Time and Weather than any Sort of Iron: In the North of *England* this Stone is called *whin Stone*.

In building a Battery with this Sort of Stone, I would recommend a Piece of strong Metal to have the

the Hole through it for the Guns Muzzle† to lie in; and that the Wall have a Slope of 35 or 40 Degrees, especially from five or six Feet below the Top.

Batteries may be made that has only Metal extending four or five Feet on each Side the Gun, to put the Gun's Muzzle in to fire through, and an Arch over the Gun, Bomb-Proof; the other Part of the Merlons may be of Masonry or Earth. This Sort of Battery will much better secure the Men and Guns, than any Battery yet built, according to the Accounts I have had from Authors, and by what I have seen. The Expence of planting Guns in this Sort of Batteries are mentioned in the second Chapter.

Batteries being faced with a sufficient Thickness of Metal, that is at least equal in Strength to the Metal Cannon-Balls are made of, there can be no Doubt that the Balls fired directly against such Batteries will break in Pieces, without making any considerable Impression upon the Battery, as may be easily proved, by taking a Ball, or if they please, one Hundred or more Balls of Stone, if a real Trial with cast Iron be thought too expensive, and throw them with a sufficient Force, or fire them out of a Gun against a Stone of the Kind, that is but three or four times the Ball's Diameter in Thickness, and well back'd with Masonry, and the Balls will all break, without making any great Impression on the Stone that broke them.

Having sufficiently explained (to those who are acquainted with Fortification) what Sort of Batteries I think is the best for Defence; I will in the next Place describe the Methods I would take in a wet Situation

† It is necessary to remember what is said in the foregoing Pages Chap. 2, concerning working Guns in these Sort of Batteries, where it is represented that the Muzzles of Guns are to lie in their Port-Holes, something like a Ball in a Socket, will that turn any Way and not make any Opening.

Situation, to fortify Places (without metal Batteries) somewhat different to the present usual Methods.

C H A P. V

IT is pre-supposed there is always Plenty of Water to fill the Ditches of the Place, spoken of in this Chapter, to a proper Height ; and also Sand, Stones and every other Material necessary for the Work, and to be had in sufficient Quantities.

In the first Place, I would have the Covert-Way upon the Surface of the Ground, supposing the Ground not above four Feet above the Surface of the Water ; and if the Place is of Importance enough for the Expence, raise Piers upon the Covert-Way about five Feet high, let their Diagonals be nearly perpendicular to the Sides of the Place, Faces of the Ravelins, &c. Lay sufficient Arches upon these Piers, take Earth from where the Covert-way is to be ; and from a narrow Covert-way that I would make (within a Foot or less of the Surface of the Water) round the Inside of the arch'd Covert-way, to make a sufficient Parapet upon these Arches over the Covert-way ; and make the Glacis with Sand, all to within eighteen or twenty Feet of the Covert-way, and cover the Sand with about a Foot thickness of Earth : There must be Steps up from under these Arches, to within about four Feet of the Top of the Glacis. *See the Plan and Profile of the Covert-way, Plate VII.*

The Ditch to be dug and faced in the usual Manner ; but in raising the Works, I would proceed in the Manner following :

Having lined the Side of the Ditch, next the Body of the Place, nearly as high as the Ground ; set off from the Inside of the Wall, six or seven Fathoms inward, and there dig a Foundation about

eight Feet broad, and about two Feet below the Surface of the Water in the Ditch ; upon this Foundation make a Wall round the Place as high as the Works are to be, and make an Arch against the Bottom of the Outside of this Wall, for a Gallery quite round the Place, and raise the Earth behind the Wall as usual, for the Rampire and Parapet ; then raise a strong Wall upon the Lineing of the Ditch, so high that the Top of the Parapet have a proper Direction towards the Glacis ; and make an Arch against the Bottom of the Inside of this Wall, also for a Gallery quite round the Place. These Arches to be made without Mortar, that Water may run freely through them. When this Wall is sufficiently dry, fill the Space between the Walls with Sand ; the same is to be done in raising the Outworks.

I would make the Insides of the Outworks of Stones, as much as possible, so that the Besiegers may not find Earth in the Outworks to raise sufficient Batteries.

The Flanks to have as much Room in them as possibly can be made ; I would casemat two Tier of Guns in the Flanks next the Ditch, the low Tier not more than three Feet above the Water in the Ditch ; and if the Height of the Works will admit of it, make a large retired Flank, to fire over the casemated Batteries mentioned above. The Method to clear casemated Batteries of Smoke, is spoken of in Chap. II.

To defend a Covert-way with Steccadoes or Palisadoes, I would make vertical Openings at the Bottom of the Breast-work or Parapet of the Glacis, in which the Steccadoes is to stand, and be capable of lowering or raising at Pleasure ; or fix Stocks or short Steccadoes about three Feet and an Half high, or their Tops to be about fifteen Inches below the

Ridge

Ridge of the Glacis, and made so as to receive a Top of about three Feet and an Half long, something of the Nature of Bayonets upon Musquets, or they may have a Joint near the Ground, by which Means they may be laid declining one upon another (somewhat like the Stalks of Corn blowed down by a strong Wind) that their Tops may lie below the Ridge of the Glacis, and yet be capable of being raised in two Minutes that their Tops shall be two Foot above the Ridge of the Glacis. It would be Madness to the highest Degree for Troops to leap over these Steccadoes, as there are a Flight of steep Steps on the Inside; it would be ten to one against every Man that he will either be killed, or hurt so much as to be unable to do any Thing against the Besieged.

REMARKS *on this Method.*

If the Sand that forms the Glacis, were laid at the Foot of the Glacis, as low as the Surface of the Water in the Ditch, it would be better; but as the digging and carrying away so great a Quantity of Earth, will, perhaps, be a greater Expence than the Advantage arising from it, therefore I have not proposed it, tho' I know the Earth will be of great Service in making Approaches upon a Glacis of Sand.

The Glacis being a Body of Sand, will cost the Besiegers much Labour to make their Approaches (especially in a dry Season, and considerable Places are generally besieged in a dry Season) for the Sides of the Trenches will run together in such Manner, as to render it almost impossible to make deep Trenches, and deep they must be or the Besiegers will suffer extremely; and the continual shaking of the Air by the Cannon and Mortars will make the Sides of the Trenches slide in more.

I am not unacquainted that much may be done in this Case, with Sand-Bags, Fascines, Stakes, and

other Inventions ; but which Way soever a Trench of six or seven Feet deep is made in Sand, it will cost much more Time than in Earth, for no Man can cast a Shovel of Sand, let the Shovel be ever so small, from the Bottom of a Trench six Feet deep upon its Side, (as much Sand must be thrown up there before) but the Sand will return into the Trench, except the Besiegers carry all the Sand first taken out of the Trenches to some distant Places, and heave little upon the Sides of the Trenches.

The Besiegers may use Means to wet the Sand a little, which will make the Sides of the Trenches stand up better than when the Sand is dry, but the wet Sand cannot be thrown any considerable Distance by Shovels ; and a Man cannot stand in the Bottom of a Trench of six Feet deep, and throw the wet Sand so far out of the Trench but it will slide into the Trench again, except as-is said before the Sand that is taken away at the first to make these Trenches be removed along the Trenches to some other Place. To make Saps, Galleries and Mines in Sand will be attended with still greater Difficulties.

The Obstructions the Parapet upon the Arches on the Covert-way will be to the Besiegers, and the Defence the Covert-way is capable of making, are mentioned in Chap. III.

The Besiegers having taken the Ravelin, will endeavour to raise Batteries in the Ravelins, or in the Places of Arms, to silence the Fire of the Flanks, (but if the Inside of the Ravelins and Places of Arms are chiefly Stones, covered only with a Thickness of Earth sufficient to prevent the Besiegers Bombs doing too much Mischief with the Stones, which Earth the Besieged may endeavour to throw into the Ditch before they quit the Work) the Cannon from the Place will do much Execution, by making the Stones fly

amongst

amongst the Besiegers all the time they are fetching Earth to raise a Battery.

M. *Belidor* and others have, in my Opinion, given sufficient Directions concerning the Ditches of Places.

When the Besiegers attempt to make a Breach in the Body of the Place, they will probably endeavour with their Cannon to lodge Miners in the Foot of the Rampier, which they may effect in the Wall of Masonry; but when the Wall is pierced, and the Miners are got into the Sand, the Water and Sand will fall in upon them and prevent their compleating a Mine there: But

There is a considerable Cohesion in almost all Sorts of Sand, when it is a little wet or humid, and a round Hole of a considerable Diameter may be dug a great Way into many Sorts of Sand, and the Sand hang like an Arch.

The shaking of the Wall in piercing it with Cannon, will also shake the Sand and weaken its Cohesion, and the two Galleries at the Bottom of the Walls will greatly obstruct the Miners, in their making Mines under the Sand, if it should be found at all practicable; where these Galleries are made, many Stratagems may be used to obstruct the Besiegers Miners, some of which will be mentioned hereafter.

When the Besiegers are preparing to batter the Body of the Place in Breach, employ (by Turns) all the Men unfit for Arms, great Boys, Women, &c. to pour Water upon the Sand between the Walls till the Sand is moderately wet; there are various Methods by which Water may be poured upon the Top of Parapets (over which it will run and sink into the Sand between the Walls) but I think we need not look for any other Method than the common Fire Engines placed in a Well or Wells made Bomb-Proof on the Capital of each Bastion, rather near the flank'd

Angle, with a Leathern Hose of a sufficient Length; it may not be amiss to have also a Well or Wells in the middle of each Curtain, by way of Caution, it not being impossible to make a Breach in the Curtain by which the Place may be taken.

When the Sand all along the Front or Fronts attacked is moderately wetted, and the Place known where the Breach is designed, the Water need only be continued pouring upon the Parapet perpendicular over that Spot, and if Stones are to be had reasonably cheap, have a sufficient Number of large Blocks of Stones ready in the Gallery behind the Wall, to fill the Gallery opposite to where the Cannon is to pierce the Wall, and where the Miners are designed to be lodged. If large Stones cannot conveniently be had, large Pieces of Timber armed with Iron will answer the Purpose, for the Water running continually upon them will prevent their being burned; and the Iron will a great while hinder their being cut in Pieces; and when the Besiegers Miners come to clear the Place, in order to make Mines there, they will not be able to move the large Stones, nor the large Timber, till they have a Number of Men and a good deal of Room, which will take a considerable Time; and the Water running continually upon them, if the Weather is cold, the Men will not be able to endure, and even in a warm Season the under-Ground Places where Water is continually dropping upon Men, will be very troublesome and discouraging.

Admit they get the Stones, or the Wood, tumbled into a Ditch, I cannot conceive how they can make any Mines, or get through the Sand, the Water continually running upon them, and the Besieged using every Means to destroy them.

It may be said the Besiegers will beat the Wall down from the Bottom to the Top, and then the
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Water poured upon the Sand will wash it into the Ditch ; but

The Wall cannot be beat down without the Besieged's knowledge, and they will cease to throw Water upon the Sand, and the Sand being a little wet will form a steep Ascent, up which a Man cannot climb till the Top of the Sand is lowered ; and before the Besiegers can come at the inner Wall to make a Breach, the Sand must be cleared away, and then the Besiegers have to begin afresh to make a Breach ; all which will require a considerable Time.

If the Besiegers have not a particular Regard to the Galleries at the Foot of the Walls, they will not clear the Sand so low as the Gallery, for to do that will cost considerable Time, as the Stones and Rubbish of the Wall and the Six or seven Fathoms Thickness of Sand cannot but make much Rubbish, which will lye a great Height before the second Wall, and the Besiegers may probably only endeavour to pierce the inner Wall at that Height ; if so, the Besieged may easily make Mines in the arch'd Gallery at the Foot of the outer Wall, and blow up the Breach there ; and also make Mines in the Gallery at the Foot of the Inner Wall, and blow up the Breach a second Time. The Contrivances that may be made use of to defend a Breach are too many to be mentioned here ; if the Reader is curious in this Respect, he may see much said on this Head in Mr. *Muller's Attack and Defence*.

When every particular of these Remarks and Works are considered, I think it will appear that the Glacis of Sand, the Parapet upon the Arches over the Covert-Way, the inner Parts of the Ravelins, and other Outworks, &c. being made of Stones, and the Sand and Water between the Walls of the Body of the Place, will (altogether) cause a greater Loss than common to the Besiegers, and oblige them

to

to spend much more time before a Place, than have been spent of late in taking the strongest.

Much more may be said, and several more Plans added, to endeavour to shew more clearly the Advantages of this new Method (of using Metal, &c. to save the Cannon and Troops in a fortified Place) has over the present Methods of Fortifying; but I leave the further Improvements that may be made in this Sort of Fortification, to some abler Engineer, who will make a proper Use of what is in the foregoing Ideas here hunted, if there be any Thing in them worth Notice.

C H A P. VI.

Of the Foundations, and the Manner of laying them.

MR. *Muller* has, in his practical Fortification, treated of the Foundations and the Manner of laying them, to good Purpose (in many Cases;) and as I have had practicable Knowledge, in, almost all Manner of Foundations, for above thirty Years last past, I hope my transcribing Mr. *Muller's* Account of Foundations will not be taken amiss, as my Intention by making Additions to Mr. *Muller's* Account, are to improve the Methods in that useful Branch,

In order to the better understanding the whole, I have inserted what I say upon each Case, at the End of what is said upon each Case in Mr. *Muller's* *Practical Fortification*. This Method I imagined the best; and what I transcribed is distinguished, so that the Reader will see each Part at one View, which being put together, doth probably make the best Account of Foundations that is to be met with in any Book now extant.

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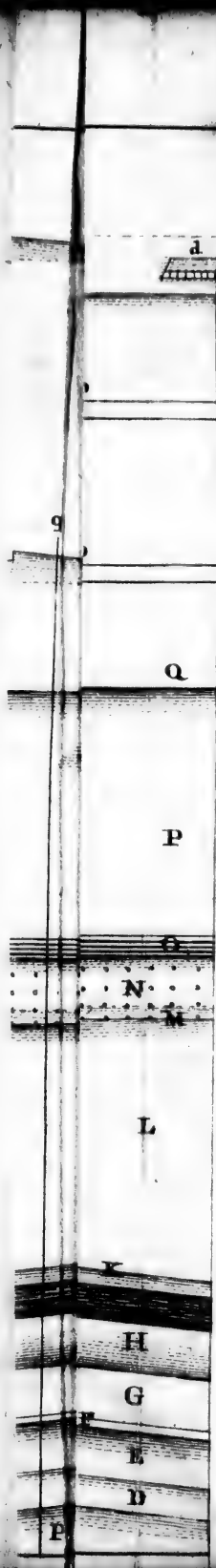
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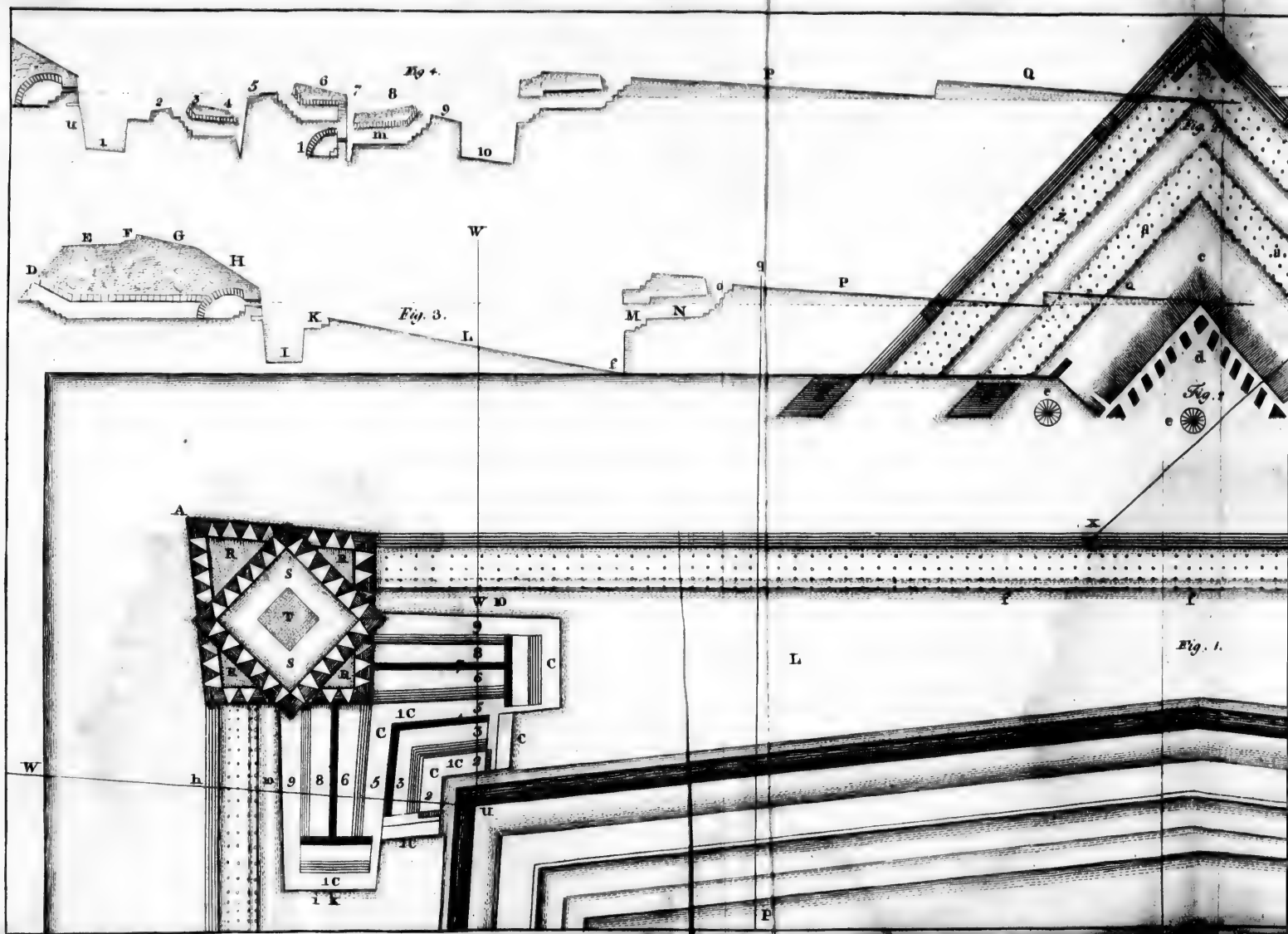
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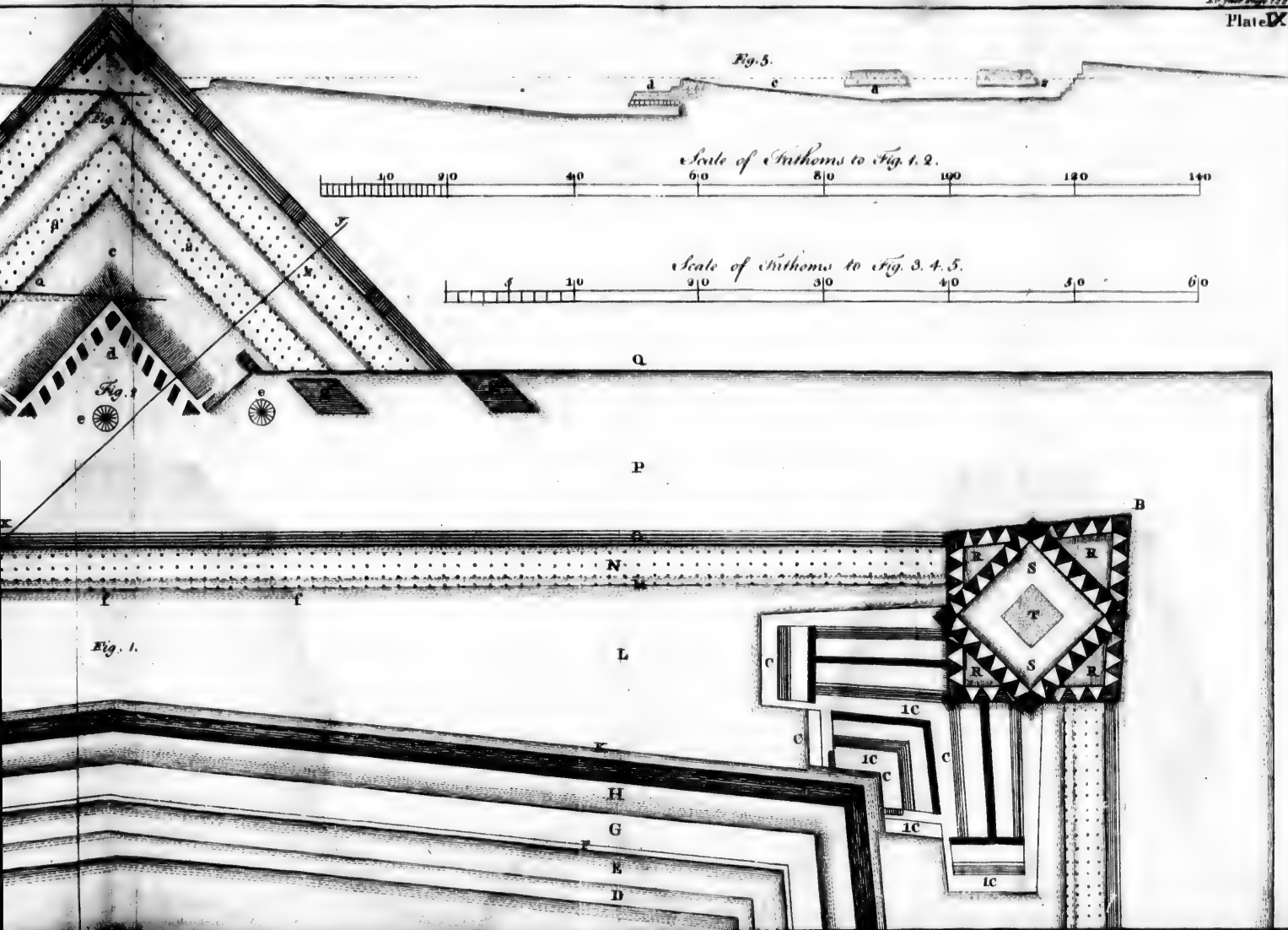
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Scale of Fathoms to Fig. 1. 2.

Scale of *Anthems* to *Fig. 3, 4, 5.*

Fig. 1.

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Plate X. “ As the Foundations of all Buildings
 “ in general, are of the greatest Importance, in re-
 “ spect to the Strength and Duration of the Work,
 “ we shall enter into all the most material Particu-
 “ lars which may happen in different Soils, in order
 “ to execute Works with all the Security possible ;
 “ because many great Buildings have been rent into
 “ Pieces, and some fallen down, for want of having
 “ taken proper Care in laying the Foundation ; and
 “ for a further Explanation we shall join here Plans
 “ and Profiles, adapted to the most material Situa-
 “ tions that can be found.”

A Desire to see the Structure appear, joined with
 some other Motives, has sometimes contributed to-
 ward making not only the Overseers, but also the
 Workmen in some Degree, endeavour to get much
 Foundation done, rather than do it well ; so that the
 Engineer should be very careful to have his Orders
 strictly followed in the making Foundations.

“ *First.* It is necessary to examine very carefully
 “ the Nature of the Soil, upon which the Foundations
 “ are to be built : For doing this, proper Augurs
 “ are used to bore in several Places 10, 12, to 15
 “ Feet deep, in order to discover the Nature of the
 “ Soil, and its hardness ; or if it is made of several
 “ Layers or Strates, which is commonly the Case,
 “ the Difference of their Nature and Goodness ; this
 “ is known by their Colour, or the Difficulty of
 “ piercing through them.

“ If the Soil be of a good Consistence, for a cer-
 “ tain Depth, without any Water or soft Ground,
 “ and this holds so all round the Foundation, there
 “ need no other Precaution be taken then to lay the
 “ Foundation four, five, or six Feet ; only observ-
 “ ing to enlarge its Breadth, in Proportion to the
 “ Height of the Walls to be built upon them, since
 “ the Higher the Wall is, the more Weight the
 “ Foundation

“ Foundation must support : Although this is self-evident, yet Engineers do not seem to mind it, because they make commonly the Baie of the Wall in Proportion to the Depth of the Foundation, and not to the Height of the Wall.

“ If the Soil be hard Gravel for about ten or twelve Feet deep, the Foundation may be built upon it, without any Danger of its sinking; or if the Soil be a stiff Clay, it will likewise be good; the first and second Figures represent the Plan of such a Foundation, where there are two or three Courses of large Stones to be put at the Bottom, and the Foundation projects by two or three Feet before, divided into as many Retreats, but not above a Foot behind, because there is no Danger of the Wall falling backwards : This is the Custom; but as for my Part, I think there is no Occasion for any Projection at all backwards, since the Counterforts are sufficient to support the Wall; and this Projection might be of greater Advantage before, if added to those already mentioned.”

The Breadth of the Bottoms of Walls in Fortification, are generally something near a Third of their Height; and the Thickness of the Top of the Wall, is, for the most Part, about half as thick as the Wall's Bottom at the Level of the Bottom of the Ditch. By Mr. Muller's Tables, a Wall 36 Feet high (Slope $\frac{1}{2}$) is 11 Feet 6 Inches thick at the Bottom, and 5 Feet 6 Inches thick at the Top; the Solidity required in Fortification, makes it necessary the Walls should be strong, but there is no Necessity to have the Wall this Thickness at the Bottom only, to enable the Earth (if clear of quick Sand) to sustain the Weight of a Wall 36 Feet high, as any one may understand by inspecting Stone and Brick Walls, whose Height are more than 36 Feet, and their Foundations not 6 Feet thick, and many not above four

four Feet thick ; and such Walls very rarely shrink by the Ground yielding under them. By many Observations and Facts, I am convinced that there are generally much more Expence bestowed upon the Foundations in Fortifications than is necessary ; which I will endeavour to shew in the Course of this Work.

In a Situation where Water prevents Trenches being made by the Besiegers in the Ditch, and the Earth is of a common Texture, there can be no Necessity to dig and lay the Foundation 6 Feet below the Level of the Bottom of the Ditch ; but if the Ditch is dry, I would lay the Foundation 6 or 7 Feet below the Bottom of the Ditch ; but the whole Thickness of the Wall need not to be sunk so low, only about 5 or six Feet Thick, with Retreats, to bring the Wall to about three or four Feet thick, at about a Foot and half (more or less according to the Nature of the Ground) below the Bottom of the Ditch, where I would dig the Foundation to its proper Width, allowing for proper Retreats up to the Height of the Ditch Bottom, see *Fig. 9* and *10*. This Foundation being properly executed will save a considerable Expence, and answer the End proposed, as well as if the whole Breadth had been laid six or seven Feet deep.

I would lay the Foundation with the broadest and thinnest Stones that can be got ; taking Care the Joints of every succeeding Course is at or near the Middle of the Stones in the Course next below, not only in the Face of the Wall lengthways, but more particularly cross-ways in the Wall : This is called by Workmen making good Bend, or Breaking the Joints well. I would build three or four Feet high in this Manner.

“ If the Soil be not very firm or hard to a sufficient Depth, or when some Parts are softer than others,
“ it

" it will be necessary to lay a Grate of Timber first
 " crossways, and then longways ; or some lay them
 " first longways, and then crossways, which seems
 " to be best ; and well bolted together with wooden
 " Tunnels, as is represented in the third and fourth
 " Figures: Sometimes, these Grates are boarded
 " over with three Inch Planks, as is marked in the
 " Profile ; at others, large Stones are laid between
 " the Timbers of the Grate, and laid even with
 " them, upon which the Foundation is afterwards
 " raised.

" Some Engineers chose to raise the fore Part of
 " the Grate of about a Twenty-fourth Part of its
 " Breadth, in order to prevent the Wall from being
 " overset by the Pressure of the Earth, as it has
 " sometimes happened. This Precaution seems to
 " me to be very necessary, especially when the
 " Rampart is pretty high ; and the Courses of Stone
 " in the Foundation should have the same Inclination,
 " excepting the last ; or the Base of the Wall
 " ought to be level, if those of the Wall are so. I
 " am sensible, that some Engineers ridicule this
 " Practice, and say, that all Beds of Stone or Brick
 " should be exactly in a Level ; but M. *Coeborn*, who
 " knew more of this Matter than most, if not all our
 " modern Engineers, has not only laid his Foundations
 " in this Manner, but likewise the Walls quite
 " up to the Top. This is confirmed by l'Abbé
 " *Dedier*, in his perfect *French Engineer*, where he
 " says, that in repairing the Works of *Manheim*,
 " which were built under the Direction of M. *Coe-*
 " *born*, they found that the Courses of Masonry
 " were perpendicular to the outward Slope, whose
 " Base is one sixth Part of the Height, and the
 " Walls were only about three Feet thick above,
 " without any Counterforts. This being the Case,
 " and the Walls being strong enough to resist the
 " Pressure

“ Pressure of the Earth, this Manner of laying Bricks
 “ and Stones has greatly the Advantage over that
 “ commonly used.

“ If the Soil be Sand, and of no hard Consistence,
 “ the Grateing the Foundation is absolutely necessa-
 “ ry ; or if the Soil be a soft Loom or common
 “ Earth, it is also necessary to take this Precaution ;
 “ and in general when the Soil is doubtful, though
 “ not absolutely bad, a Grating such as this cannot
 “ but be very useful in preventing the Walls from
 “ sinking ; and I must repeat it again, when the
 “ Wall or Rampart is very high, particular Care
 “ should be taken to secure the Foundation in the
 “ best Manner possible, for it is better to do this
 “ though somewhat more expensive, than to run
 “ the Chance of making bad Work at an easier Rate
 “ which might prove more burthensome at the End.

“ It is necessary to observe, that when there is
 “ any Timber under the Foundation, the first
 “ Course of Stones should be made without Mortar,
 “ because its Corrosiveness destroys the Wood ; and
 “ in general, where any Beams or Timber are laid
 “ into the Masonry, instead of Mortar, stiff Clay
 “ is used round it ; and some Carpenters make thin
 “ Cases of Wood round the parts which enter into
 “ the Wall.

“ When the Foundations are so very bad, that the
 “ Grate of Timber mentioned before, is not suffi-
 “ cient, but is hard after a certain Depth ; upon such
 “ an Occasion, it is proper to drive Piles, and then
 “ lay a Grate over them, such as is represented by
 “ the fifth and sixth Figures : These Piles are to be
 “ placed exactly under the Crossings of the Timber,
 “ to which they are fastened with Trunnels, and
 “ are to be drove into the Ground as far as they will
 “ go.

“ A

“ As this Method of laying Foundations happens
 “ most frequently in the Works of a Fortrefs, and
 “ is very expenfive, Care must be taken not to make
 “ any more than what is necessary. In order to find
 “ the proper Length of the Piles, one or two are
 “ drove as deep as they will go, and then cut a
 “ certain Number of the same Length, and when
 “ these are drove, and the Depth of the Foundation
 “ remains the same, more are cut of the same
 “ Length ; but if the Foundation changes, the rest
 “ must be made accordingly. By this Method a
 “ good deal of Timber may be saved ; whereas, if
 “ the Piles are all cut at once, some may happen to
 “ be long, and perhaps some too short ; which wastes
 “ a great deal of Timber to no Manner of Purpose.

“ Some Engineers drive Piles into every Corner
 “ of the Squares formed by the Timbers, and none
 “ under the Frame, as is represented here ; but this
 “ Method must appear to every judicious Reader,
 “ not so good as the former, because the Frame is
 “ supported by nothing but the Earth, which being
 “ but soft, must give way to the great Weight of the
 “ Wall pressing upon the Frame.

“ Others drive not only Piles under the Grate, as
 “ we have said above, but likewise two in every
 “ Square ; that is, in the opposite Angles : But it
 “ seems to me not worth while to make such expen-
 “ sive Work without an absolute Necessity, and
 “ when no other Method is practicable.

“ Besides the Piles under the Grating, others are
 “ to be drove at the Outside next to the Ditch, as
 “ is represented in the Plan by the Letter a, their
 “ Number is uncertain, and ought to be regulated
 “ by the Goodness or Badness of the Foundation.
 “ In both Foundations, represented by the third and
 “ fifth Profiles, the outside Timber next to the
 “ Ditch, ought to be cut in such a Manner that the

“ Wall

“ Wall may rest upon Part of it, and the other Part
 “ prevent it from sliding into the Ditch ; or else a
 “ smaller Timber should be fastened with Bolts upon
 “ the larger. M. *Belidor* gives an Example of a
 “ Wall sliding in the Ditch, at *Bergue St. Vinoc* in
 “ *Flanders*, which was the Face of a Ravelin ; the
 “ same Thing happened some Years ago, at our
 “ Wharf here, at *Woolwich*, for the middle Part
 “ of it slid five or six Feet into the *Thames*, because
 “ the Foundation was only Clay rammed even with
 “ the Bed of the River, and which would have been
 “ sufficient, had the Precaution abovementioned
 “ been taken.

“ We have mentioned before, that sometimes
 “ Planks are used to cover the Grating, and some-
 “ times not ; where there is Plenty of Stones, these
 “ Planks may be saved ; but in Walls made of Brick
 “ they are absolutely necessary ; for they being but
 “ of a small Size, those which rest upon the Timber
 “ will not be able to sustain those which are between
 “ them.

If the Ground be not very firm to a sufficient
 Depth, or when some Parts are softer than others, I
 would (the Foundation being dug) drive a Row of
 dove-Tail Piles, as far as they will go, before the
 Front of the Foundation, their Heads standing about
 6 Inches above the Bottom of the Wall ; (which is
 built close against the Inside of the Piles) where the
 soft Places are, put a String of Oak about 8 Inches
 by 6 against the Outside of the Piles, about 10 or 11
 Inches below where the Bottom of the Stone or Brick
 Work is to be ; cut Openings in the Pile Heads as
 low as the upper Edge of the String of Oak that is
 fastened to the Outside of the Piles, these Openings
 may be 10 or 15 Feet asunder, (more or less accord-
 ing to the Hardness of the Ground ;) fit into each of
 the above mentioned Openings a strong Piece of
 K Timber

Timber with its End about 20 Inches without the Piles, having either a Notch cut, or a Piece of good Timber about four or five Inches thick, fastened with good Tree-Nails upon the under Side at the End, to take good Hold of the String of Timber mentioned above ; these Timbers or Sleepers must be at least two Feet longer than the Breadth of the Foundation, and have Pieces 5 or 6 Feet long a-croſs the inner Ends, to aſſiſt the Dove-Tail Piles in preventing the Foundation ſlipping forward, and let the outer Ends of the Timbers lie a little higher than their inner Ends, if the Earth-work is carried up a-long with the Wall.

Lay the Foundation (between the Timbers) upon the Ground with the broadest and thinnest Stones that can be got, and carry up the Foundation 3 or 4 Feet high, with these broad Stones as mentioned before, but if broad Stones are not to be had, nor Bricks sufficiently broad, and the Ground is very soft, Planks, or something near equal to Planks, must be laid longways upon the Timber ; but in this Case, when the flat Stones are not to be had, the upper Sides of the Sleepers must be laid near 8 Inches below the Top of the Dove-Tail Piles, and the Earth ram'd firm and close, and as high as the Sleepers : If every Sort of Materials are not to be had, the Engineer must adapt his Methods of executing the Works to the Materials he can get ; but to give a full Account of all the Methods of proceeding, in all the Cases that can happen in Practice, will take more time than I have in my Power at present. When it is necessary to cover the whole Foundation with Plank, (and Pileing may be omitted) I would only lay Sleepers in the Manner mentioned above, and lay Planks longways, well tree-nailed upon the Sleepers ; this will be a less Expence, and not less good than a Frame covered with Plank : In Order to understand this,

this, it is necessary to consider that the principal Uses of Timber and Plank under Walls (that Seas nor Streams doth not run against) is to make the Weight of their Foundations lye equally upon the Ground in every Part, and secure the Bottom of the Wall that it do not Part, nor slip from its Place ; now I think every one of Judgment will allow there is little or no Danger that a Wall back'd to its Height with Earth, will fail any Way so soon as forward. Therefore

The principal Care is to have the Forepart of the Foundation well secured, which may be done at a small Expence when the Foundation is making, see the Method *Fig. 9* and *10*. As the Walls cannot fail lengthways (except at an outward Angle) I would lay no Timber lengthways in the Foundations (Plank laid lengthways being very sufficient) except where the Ground is so very bad, that Piling is necessary the whole Breadth of the Foundation.

When an outward Angle must be upon a soft Spot of Ground, particular Care is required in making the Foundation, and the more especially so, if it is the Epaul or Shoulder of a Bastion ; In this Case, the Foundation may be made broader (forward) than the other Parts of the Wall, for twenty or thirty Feet each Way from the Coyn or Angle, and have broader Retreats to bring the Wall straight at the Bottom of the Ditch. If the Ground is very soft to a Depth that Piles cannot be of much Service, the Necessity is greater to make the Foundation very broad, and lay long Sleepers well covered with Plank, and one or two good Rows of Dove-tail Piles on each Side along the Fronts with broad Planks laid flat upon the Ground, one without and one within the Dove-Tail Piles lengthways all along ; upon which Planks the Ends of the Sleepers are to lie a-crofs and be well fastened to them with good Tree-nails, but if the

Earth Works are raised with the Wall, there need not be Dove-Tail Piles in the Inside: I would lay this Foundation level, for I think all Foundations should be laid level where the Ground is very soft to a great Depth; my Reasons for thinking so are these following:

The Inside of Walls that have outward Slopes, are heaviest upon the Foundation; and, the Walls whose outside Slope is but $\frac{1}{2}$ when built to their Height, and left to dry some Months before any Earth is put behind them, if their Bottoms are laid lower behind than before, in a soft Soil will settle backwards, notwithstanding the Counterforts; and if the Soil is so soft as to rise or bulge up as the Wall settles, the Bottom of the Wall will press forward, and the Top incline backward, perhaps too far before the Earth can be raised to hinder it; besides, the laying Earth against the Bottom behind the Wall in this Case, will add to the Pressure forward at the Bottom, and make the Top incline backward in Proportion.

If a Row or two of good Dove-Tail Piles are driven a sufficient Depth at the Front of a Wall, and their Heads secured from pressing outward, the Ground must be very soft that will not support the Walls without the Expence of piling and laying Frames of Timber in the Foundation; but as nothing but Practice, joined with Art, can make an Engineer a good Judge of Foundations, I would advise young Architects to take every Opportunity of seeing Foundations of all Kinds: When any very considerable heavy Piece of Work is undertaken, I would spare no reasonable Expence to be well informed of the Foundation, especially by consulting several of the most practical Engineers, tho' some of them are fetched five Hundred Miles or more.

“ If the Foundation is either all Rock, or only partly so, the Bed of the Wall is to be sunk about
fix

“ fix Inches or something more into it, in the Man-
 “ ner represented in the seventh Figure, to prevent
 “ the Wall from sliding, which otherwise might hap-
 “ pen, because Masonry seldom binds so well with
 “ the Rock as to make it firm and durable. When
 “ the Bed is made, Care must be taken to sweep it
 “ very clean, in order that no Rubbish or Dust re-
 “ mains in it, and after this, it must be wet as the
 “ Wall is made ; by doing so, the Mortar will en-
 “ ter better into the Pores and small Cavities,
 “ the Masonry will likewise bind with the Rock
 “ in a more easy Manner, and form in time but one
 “ continued solid Stone.

“ Although Rock is the strongest Foundation
 “ that can be built upon ; nevertheless, Engineers
 “ look upon it as one of the most difficult Pieces of
 “ Work to be met with ; their Reason for thinking
 “ so is, that they are seldom level, but rise and fall
 “ continually, by which the Work changes its Pro-
 “ file at every small Distance ; and to raise the Foun-
 “ dation to to a proper Level, and bind the Mason-
 “ ry to the Rock in a strong and firm Manner, meets
 “ with the greatest Difficulty.

“ The securest Manner of proceeding in such a
 “ Case, is, to clear the Rock as well as can be, from
 “ all Dust and Rubbish, in the Manner observed be-
 “ fore, and to sink from four to six Inches into it ; then
 “ raise the lower Parts with good Masonry made of
 “ very thin but strong Mortar, so as to be in the
 “ same Level with the higher ones. This Work
 “ must be left some time to dry and settle, otherwise
 “ that Part of the Wall which stands upon the made
 “ Foundation will sink and break off from the Parts
 “ which stand upon the Rock.

“ Sometimes the Rock will rise at one End nearly
 “ as high as the Wall itself ; in this Case, the Work
 “ must be raised to a Level of about 6 Feet from the



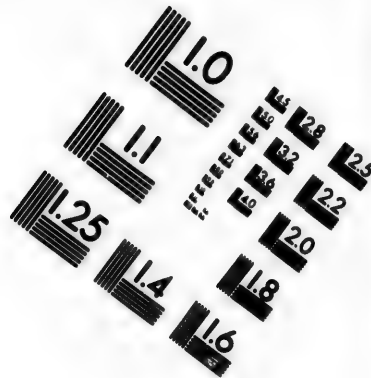
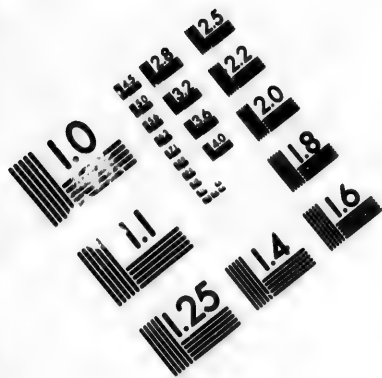
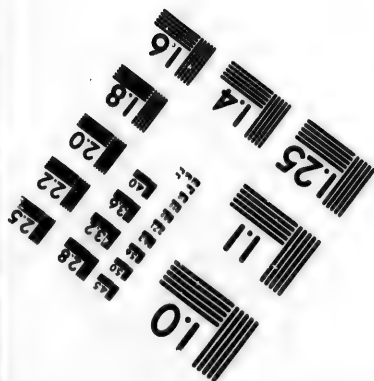
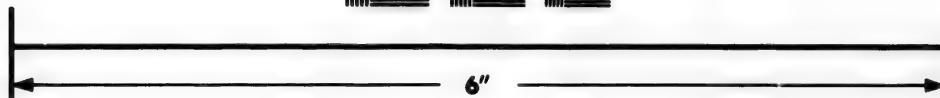
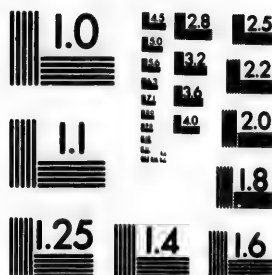


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“ Bottom, and then left to dry and settle for some
 “ time ; after that, it may be raised to the same
 “ Height again till such Time as the whole Wall is
 “ finished ; and to prevent the Workmen from stand-
 “ ing still, several Parts may be undertaken at the
 “ same Time and carried on alternately.

“ Sometimes it happens, that the Rock rises gra-
 “ dually behind, nearly as high as the Wall, or
 “ which is the same, that a Wall is to be built a-
 “ gainst the Rock ; in this Case, the Rock must be
 “ well cleared from all Dirt and Rubbish ; and if it
 “ is too smooth, it must be pickt, or small Cavities
 “ made in it, that the Mortar may lay hold of, and
 “ bind it with the Masonry ; and the Work must be
 “ carried on gradually and slowly, otherwise the
 “ Masonry will naturally sink and tear off from the
 “ Rock.

“ M. *Belidor* proposes a Method for Building
 “ Walls in this Case, which, he says, has often been
 “ practiced by some *French* Engineers with good
 “ Success ; that is, instead of using common Mor-
 “ tar and Stone in the usual Manner, they prepare
 “ what is called Stone Mortar ; which is made of
 “ thin but strong Mortar mixt with Stones, about
 “ the Size of a Walnut ; a little more or less ;
 “ then they set a kind of Coffin without a Bottom,
 “ cut underneath, so as to agree nearly with the un-
 “ evenness of the Rock ; then this Coffin is fil-
 “ led with Mortar, and let stand till it is dry and
 “ pretty hard ; then they take the Coffin away in
 “ order to place it elsewhere. The Reader may ea-
 “ sily perceive, that the Surface of this Mortar is
 “ laid smooth and level, and that, when it is well
 “ settled, will stick much better to the Rock than
 “ any other Kind of Work whatsoever ; these Kinds
 “ of Walls become in time as hard as Stone itself,
 “ as

“ as appears by the Remains of such as have been
 “ found here, in *France*, and in *Germany*.

“ In some Parts of *Scotland*, in *Ireland*, at *Gibraltar*, and *Mabon*, the Rocks are generally of
 “ Lime-Stone ; in such a Case, no better Work can
 “ be made, than to mix the Stones of the same Rock
 “ with the Lime ; this will, by the Likeness of the
 “ Parts, form a Work that will join to the Rock,
 “ and in time become as one continued Stone.

“ It happens sometimes that under a Bed of
 “ Gravel, Clay or any other hard Consistence, there
 “ is a soft watery Soil or Sand to a great Depth ;
 “ where it would be dangerous to drive Piles, on
 “ Account of the Sources or Springs, which are
 “ generally under these Places, which when they
 “ once get a Vent or Opening, fill the Trench made
 “ for the Foundation in a short Time full of Water,
 “ in such a Manner, as there is no Possibility to
 “ build there. When this happens, a Gutter must
 “ be made to lead the Water out of the Trench into
 “ some Well made for that Purpose, if none is found
 “ near enough, and Engines set to work to draw the
 “ Water out of it into some lower Place or Ditch.

“ It may happen, that the Water comes so fast
 “ into the Trench as not to be drawn off ; in both
 “ Cases, a strong Grate of Timber must be made,
 “ and plank'd over, which being laid over the Foundation,
 “ and fastened in such a Manner as not to
 “ shift its Place ; then the Masonry is built upon it ;
 “ by which it will sink gradually till it comes to the
 “ Ground, and when the Foundation is raised above
 “ Water, it is left to dry and settle before the Wall
 “ is continued.

“ I have been assured by People of Veracity, and
 “ Judges of these Works, that many such Instances
 “ happen in *Russia*, as well as in *Flanders*, and yet
 “ when the Walls are finished, they stand neverthe-
 “ less

“ less as firm as if they where built upon a strong
 “ Foundation ; it is certain that these Walls will
 “ sink, but then the Business is to make the whole
 “ go together without Clinks or Breakings ; which
 “ can no otherwise be done, than with very good
 “ Materials, and great Care and Induitry.

“ Notwithstanding that no Water appears above
 “ Ground, and that there is only a hard Crust of
 “ five or six Feet deep over a swampy Soil, yet it is
 “ necessary to lay a strong large Grate under the
 “ Foundation, by taking Care to sink the Trench
 “ as little as can be done, for the Safety of the
 “ Work ; and the Foundation must be carried all
 “ round alike by horizontal Courses, and no new one
 “ begun before the last be quite finished ; so that if
 “ the Ground underneath gives Way, it may be
 “ pressed alike every where, and sink together.

“ This Method of carrying on the Foundation
 “ alike all round the Work, should be observed
 “ every where, excepting on Rocks, or such a hard
 “ Substance that cannot give way ; where it may be
 “ done by Parts one after another, only observing
 “ to join them well together, and by Steps, that no
 “ two Joints may be over one another.

“ There are some Situations, which besides being
 “ swampy, the Trench dug for the Foundation fills
 “ in a short time with Water ; the Method used upon
 “ these Occasions, is, to open only as much of it as
 “ can be made in a Day, and the Stones are laid,
 “ without any other Precaution, on the Ground, and
 “ the Work is carried on as fast as possible, till the
 “ Walls is above the Height to which the Water
 “ rises ; but this Foundation must be made very
 “ broad and by Retreats, and the Stones laid in
 “ Tarras-Mortar, that it may soon grow hard ; when
 “ this is done all round, and the Work settled, the
 “ rest is built in the usual Manner.

“ These

“ These Kind of Foundations are very common
 “ in *Flanders* ; and M. *Vauban* was very much puz-
 “ zled at first how to proceed, till some Workmen
 “ of the Country, which had been used to them, put
 “ him in a Method of it. I have seen the same at
 “ *Douay*, where they dug a Trench of about 140
 “ Yards, and three Feet deep ; and as fast as it was
 “ opened, the Masons worked at the Foundation,
 “ which was raised 6 Feet high ; though the next
 “ Day half of it was under Water, yet the Work
 “ stood as well as if it had been built upon a solid
 “ Foundation.

“ As the different Situations and Soils require
 “ different Precautions, it is impossible to give par-
 “ ticular Methods for every one ; the most secure and
 “ probable by which an Engineer may succeed, is,
 “ to consult the Workmen, who either live upon
 “ the Spot or near it, and who have been employed
 “ in such Foundations ; for they generally know best
 “ what Method will most likely succeed ; by con-
 “ sulting several upon the same Subject, if they dif-
 “ fer in their Opinion, which is often the Case, it is
 “ the Engineer’s Business to judge what is best to be
 “ done, and from his own Experience, joined to that
 “ of the Workmen, deduce the Method by which
 “ he is to carry on his Work : But notwithstanding
 “ all human Precautions that can be taken, yet Ac-
 “ cidents will happen, which are to be repaired as
 “ soon as possible, and whereby the Engineer will
 “ learn how to avoid them afterwards, in the Re-
 “ mainder of his Works.

“ We have endeavoured to give here most of the
 “ several Cases which commonly happen in all
 “ Foundations made upon the Land ; and which,
 “ if studied with Care, I do not doubt but an Engi-
 “ neer with a moderate Share of Practice and
 “ Knowledge, will be enabled to perform such
 “ Works

“ Works: But the Manner of laying the Foundati-
 “ ons in Water for Bridges, Sluices, Moles and
 “ Piers for Harbours, will be treated of seperately in
 “ the latter Parts of this Work, *i. e.* The latter
 Part of *Muller's Practical Fortification*.

When every Part of the Foundation is Rock, there cannot be any Danger of Settlement, nor Difficulty in laying the Foundation; but when there are high Pieces of Rocks which serve for Part of the Wall, and in several Places the Ends of the Wall not only joins the Rock and sets on upon it lengthways, but some Part or Parts of the Wall must be built against the Face of the Rock; in such Cases, it is somewhat difficult (without good practical Knowledge) to make the Work join the Rock so as not to shew at the Rock and Wall's Meetings some Shrinkings of the new Work. The Form of the Rock must in a great Measure determine the Butting of the Wall against it. I would chuse to make the highest Buttings, and consequently the fewest the Rock will admit of, without too much Labour; cut the End of the Rock where the Wall is to join it vertical, making the Coyn of the Rock about 75 or 80 Degrees, so the Back Part of the Front Stones will be longer than the Forepart (in Nature of a Dove-Tail) and confine the Wall that it cannot settle forward; and to prevent the Wall from lowering by the drying of thick Beds of Mortar, the Stones must be laid so close as the Nature of the Work will admit, without bestowing too much time. The Wall being raised so high as the Butting, and, where it must be made longer by being set upon the Rock at one or both Ends, if Circumstances will admit, let it dry at the Height of every Butting, before more is built upon it; but,

If there is any great Necessity, the Wall may be built to its Height in many Cases without letting it stand

stand to dry, and without any considerable Detri-
ment if the Foundation be upon the Rock, and the
Weather dry and warm, by observing the following
Directions :

Let the Stones be dry ; but wet their Outfides
when they are put into the Mortar, and make all
the Beds of the Stones good, and lay thin Beds of
Mortar ; when the Wall is extended over a Butting,
upon the Rock, lay a thick Bed of Mortar under the
first Stones that lye upon the Rock over the Butt or
Joint, that the Wall may not hang upon the Rock
by its upper Parts, and so not stand with its whole
Weight upon its Foundation, by which the lower
Part of the Wall will be easy to pull out, not having
the Weight of the Wall above to hold it fast ; if the
Wall doth not extend over the Butt or Joint upon
the Rock too far, lay long Stones to hang in the Wall
and reach the next Butting, and be about half an
Inch clear above the Rock, that the Wall is exten-
ded upon ; put no Mortar between the Rock and
this Stone, and the whole Weight of the Wall will
be upon the Foundation, and the Wall will settle
properly.

To build upon a soft Foundation, and the End or
Ends of the Wall Butt against a Rock ; follow the
above Directions till you come to extend the Wall
upon the Rock above the first Butting of the Wall
and Rock ; taking particular Care no Part of the
Wall be built to hang upon the Rock, so as to hin-
der its settling all together ; and when you extend
the Wall upon the Rock, let each Course overset
lengthways the whole Breadth of the Wall, like the
under-side of a Flight of Steps, leaving a Space be-
tween the Rock and the Wall, that a Man can go in
(when the Wall is sufficiently settled) and begin at
the Backside of the Wall, to close the Wall to the
Rock, working outward, taking time and Pains to
do

do the Work well, making well fast every Height to the Work above, with good hard flat Stones and Oyfter-Shells, which is called *pinning* among Workmen. There must be good Bond made, especially from the back Side of the Wall to the Front: Every good practical Mason knows how to do this Work to answer the End, as well as if the Wall had been carried up altogether.

It is not difficult to build a Wall to stand firm against the Face of a Rock, if the Rock can be cut in the common Way, let the Face of it be ever so irregular and sloping; I could mention several Methods, but at present I will only explain one Method, which I will adapt to the most difficult Case I can think of, where the Rock can be easily cut by the common Methods.

Admit the Face of a Rock is to be built against, whose Bottom is nearly upon a Line with the Fore-Part of the Foundation, and slopes 6, 8 or 10 Inches in every Foot in height, for any Number of Feet, suppose 6 or 8 Feet high; and at that Height overhangs, or goes upright, or ever so irregular 3 or 4 Feet, more or less in Height, and the Bottom of the Rock at or above the Surface, slopes backward, downward, so that no Hold can be got of the Rock for a Foundation; if it is only a Rock of eight or ten Feet broad or thereabouts, an Arch may be sprung from the Foundation, on each Side, to build the Wall upon before the Rock; but if the Rock is large, the Ground must be dug from its Face, and a Foundation made, and if the Rock below is almost as far out as the Foundation on each Side, so that there is not a sufficient Breadth for a Foundation to keep strait with the other Foundation; the Foundation before the Rock must be laid out farther than the other Foundation a sufficient Breadth, with broad Retreats.

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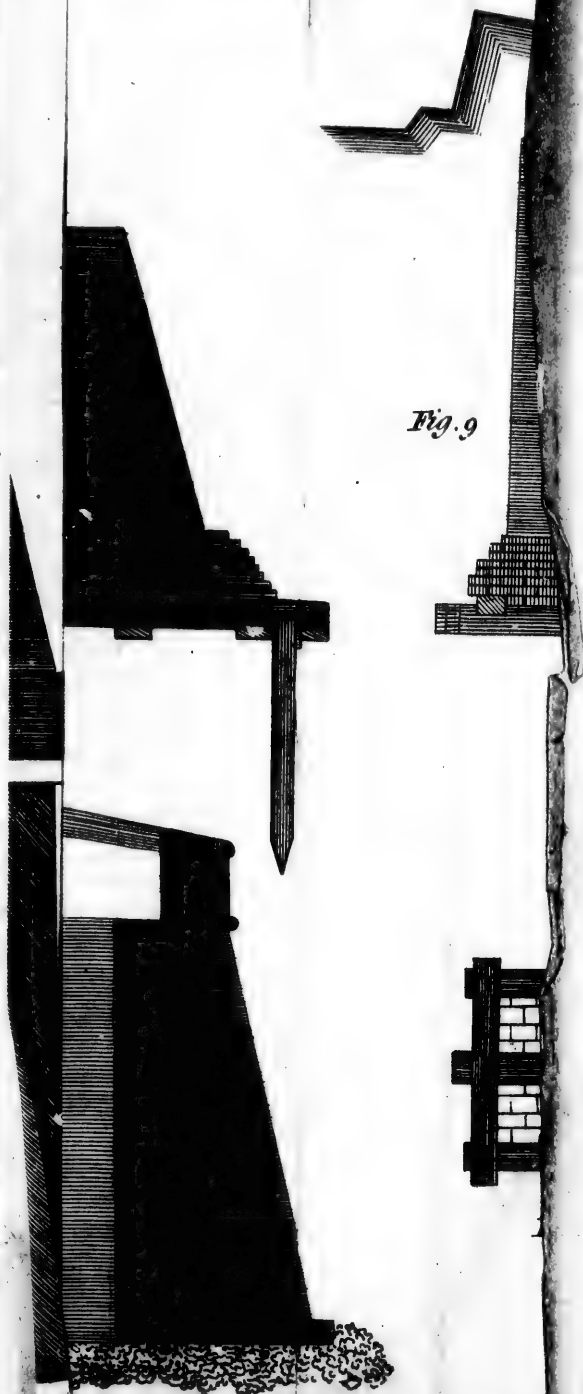


Fig. 9

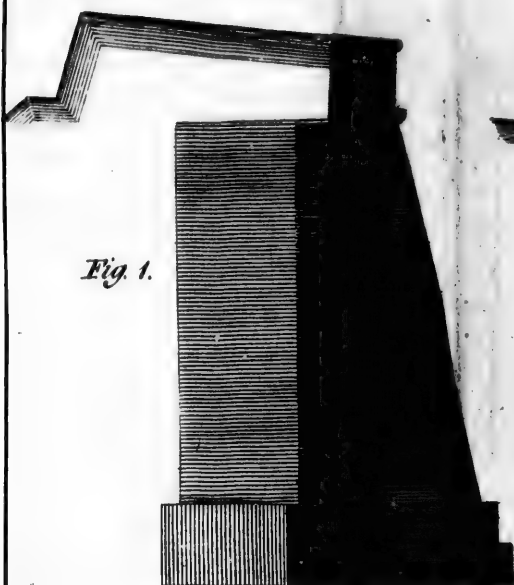


Fig. 1.

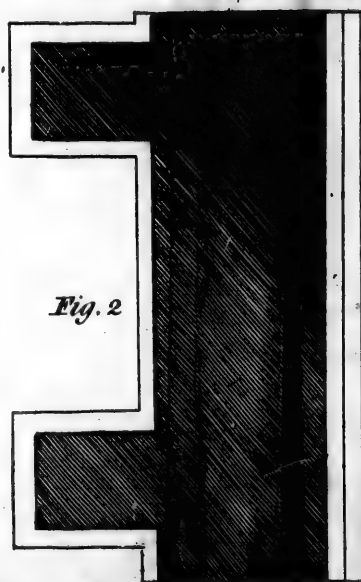


Fig. 2.

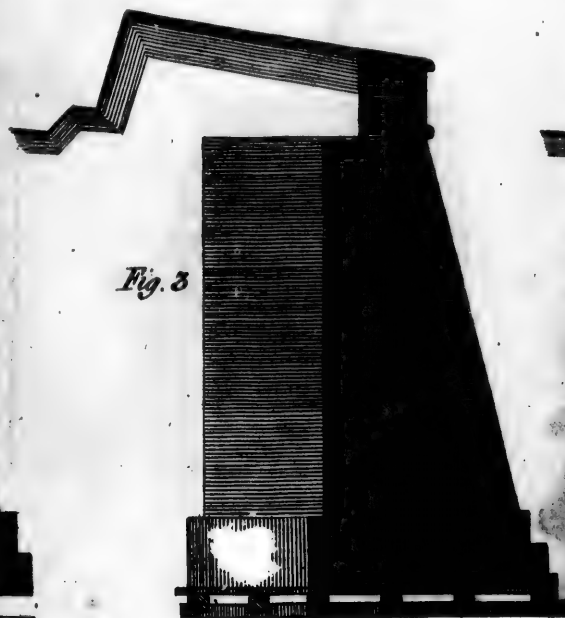


Fig. 3.

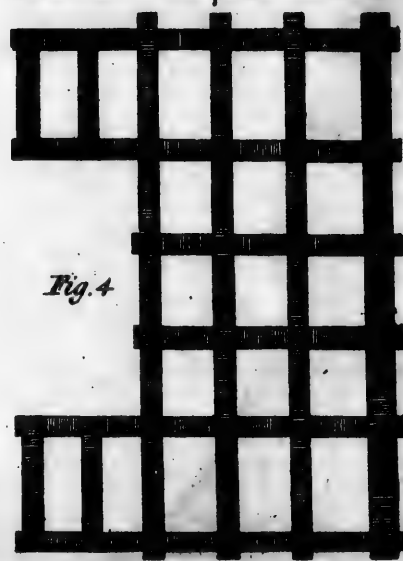


Fig. 4.



Fig. 5.

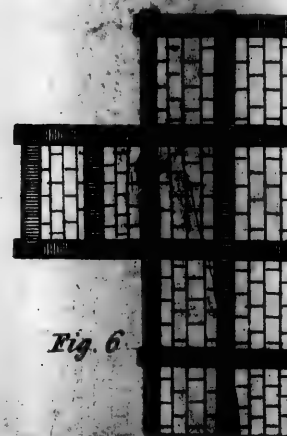
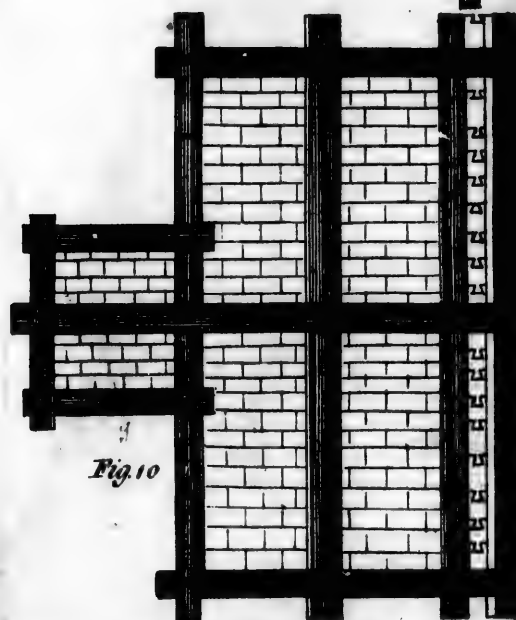
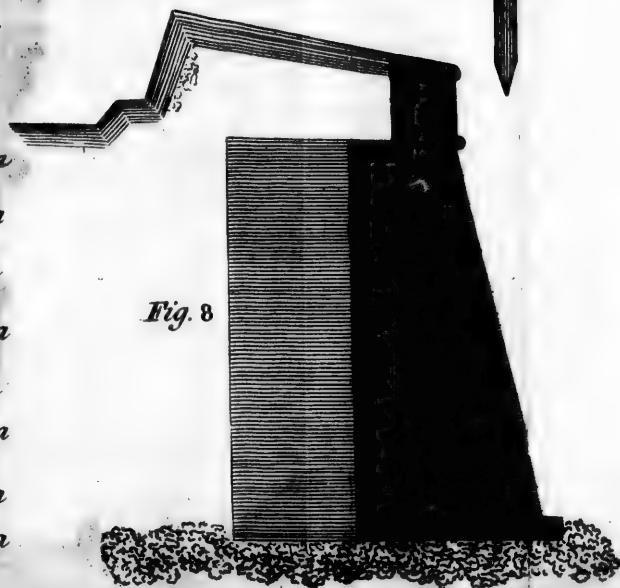
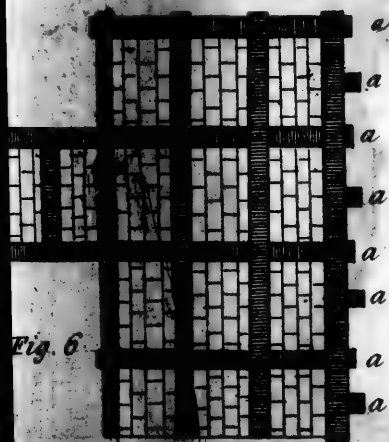
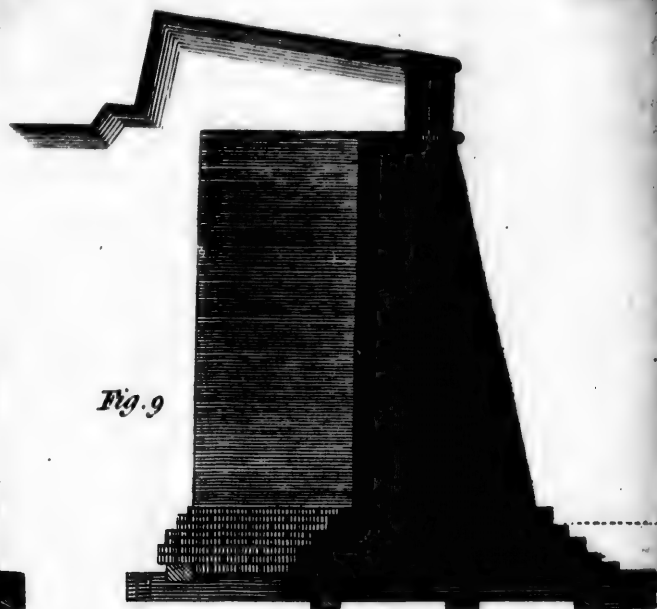
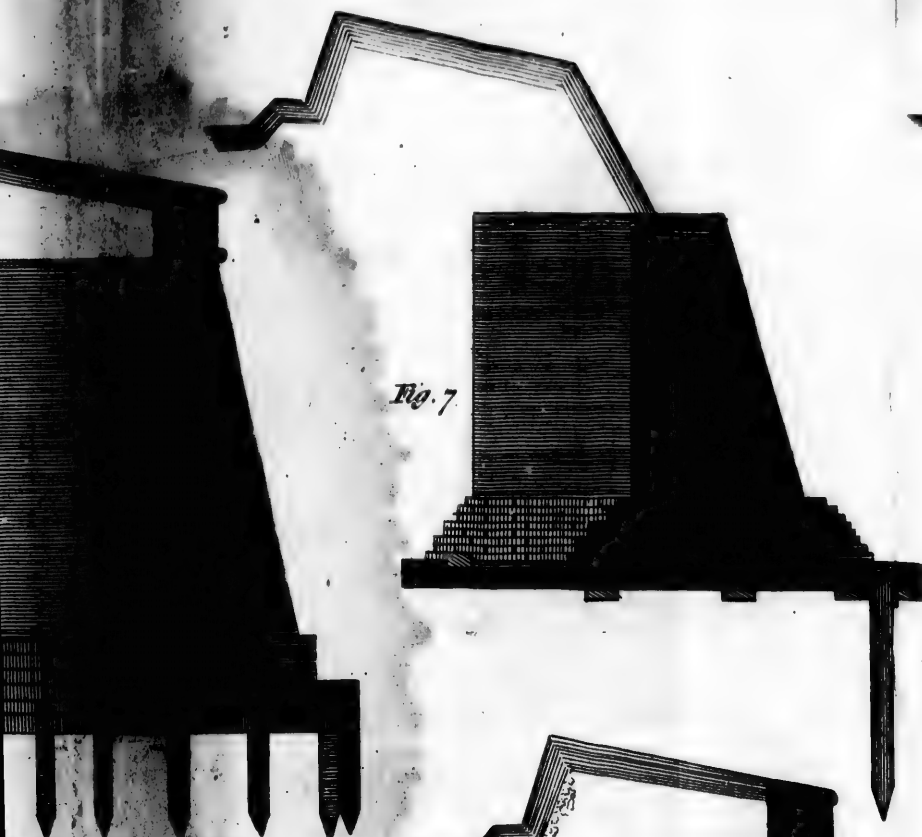


Fig. 6.



Retreats to bring the Wall strait at the Surface or Foot of the Rock.

The next Thing to be done is to cut vertical Dove-tail Grooves in the Rock, about a Foot deep, 18 Inches broad at the Bottom, 16 at the Top or Surface of the Rock that is to be built against, and about 8 or 10 Feet asunder; in carrying up the Wall fit long Stones into these Grooves (but not close to the Bottom of the Groove,) and let every second Stone reach the Front of the Wall (when you can) and lye upon a Stretcher, till the Wall becomes too thick for one Stone to reach, then lay two or three Stones to reach the Front, taking Care to make very good Bond from the Dove-tails; and if every third Course is cramp'd together with Lead, it will greatly add to the Security of the Work. These Dove-Tail Courses cannot fail of holding the Wall fast to the Rock; and if Care is taken to keep the Rock very clean, and use good Mortar properly against the Rock, and pour thin Mortar against the Dove-Tails, there cannot be any Doubt of the Wall standing firm against the Rock.

Some Rocks are so hard that it will cost much Time and Labour to cut Dove-Tail Grooves; but as they are the best Contrivance that I know, I would cut them tho' the Rock be as hard as Marble; but if the Rock be of the Pebble Kind, Drills may be used to good Purpose to make Taggle-holes in the Rock, to hold the Wall; for I cannot think that even the best Mortar will always, and in all Cases, hold a Wall to a Rock that has a gradual Slope; but Dove-Tail Grooves and Taggles will always answer the End if properly executed.

As to the Building Walls formed in Cases, or Coffers, with thin strong Mortar and small Stones, I can only approve of such Work where good Stone is not to be had at a reasonable Price. I have observed

served old Buildings some Part of whose Walls are of this Sort of run-Work, and the other Part of common Stone and Mortar built in the usual Manner; and that Part endures much better that is built with Stone and Mortar in the usual Manner, as appeared to me upon inspecting the Walls of *Portchester* Castle near *Portsmouth*; and the Walls of the City of *Norwich*, and other Places. Much may be said on this Subject; but as I do not in this Place intend to treat of all the Methods of building Walls, I will only say, had I a Wall to build with small Stones and thin strong Mortar, I would first mould the Materials like Bricks, but much larger, and let them dry, and with them build the Wall in the common Way, as with squared Stones and Mortar.

Of Foundations for Piers and Bridges.

Mr. *Mullar* in his practical Fortification, has collected Methods used in making the Foundations of Piers for Bridges and Harbours, and I hoping to be useful herein have made Additions; but as a full Description of all the Methods that are and may be practiced in Foundations, would alone make a considerable Volume, I will here only endeavour to show how Foundations may be made in the most difficult Cases; some of which Cases I have extracted out of Mr. *Mullar's Practical Fortification*, on Purpose to shew they are looked upon as the most difficult Cases, and some of them thought impracticable; but I hope what I shall add, will make the most difficult Cases mentioned by Mr. *Mullar*, appear practicable.

CASE I.

After a short Description of the Building of *Westminster-Bridge*, Mr. *Mullar* says, " This Method
" of building Bridges is certainly the easiest and
" cheapest that can be thought of, but cannot be
used

“ used in many Cafes : When the Foundation is
 “ so bad as not to be depended upon without being
 “ piled, or the Depth of Water is very great, with
 “ a strong Current and no Tide, I do not see how
 “ it can then be practised. For if Piles are to be
 “ used, it will be next to impossible to cut them off
 “ in the same Level five or six Feet below the Bed
 “ of the River, notwithstanding that Saws have been
 “ invented for that Purpose ; because if they are cut
 “ off separately, it will be a hard Matter to do it so
 “ nicely that the one shall not exceed the other in
 “ Height, and if this is not done, the Grating or
 “ Bottom of the Coffers will not be equally support-
 “ ed, whereby the Foundation becomes precarious :
 “ Neither can they be cut off altogether ; for Piles
 “ are to be driven as far as the Bottom of the Coffers
 “ extends, which at *Westminster*-Bridge was 27 Feet ;
 “ the Saw must have three Feet play, which makes
 “ the total Length of the Saw 30 Feet ; now if ei-
 “ ther the Water is deeper than it is there, or the
 “ Arches are wider, the Saw must still be longer ;
 “ so that I leave the Reader to judge whether this
 “ Method be practicable or not, in any such like
 “ Cafes.

C A S E II.

“ In a great Depth of Water that has a strong
 “ Current and no Tide, the Coffers must reach a-
 “ bove the Water, which makes them very expen-
 “ sive, and unweildy to manage, as well as very
 “ difficult to be secured in their Places, and kept
 “ steady : So that there is no Probability of using
 “ them in such a Case.

“ In some Cafes when there is a great Depth of
 “ Water, and the Bed of the River is tolerably level,
 “ or can be made so by any Contrivance, a very
 “ strong Frame of Timber about four Times as
 “ large as the Base of the Piers, may be let down
 “ with

“ with Stones upon it round the Edges to make it
 “ sink : After fixing it level, Piles must be driven
 “ about it to keep it in its Place ; and then the Foun-
 “ dation may be laid in Coffers as before, which are
 “ to be kept steady by means of Ropes tied to the
 “ Piles.

“ This Method has frequently been used in
 “ *Russia*, as I have been assured by a Gentleman who
 “ has seen it. Though the Bed of the River is not
 “ very solid, yet such a Grate, when once well set-
 “ tled with the Weight of the Pier upon it, will be
 “ as firm as if Piles had been driven under the Foun-
 “ dation ; but to prevent the Water from gulling
 “ under the Foundation, and to secure it against all
 “ Accidents, a Row of Dove-Tail Piles must be
 “ driven quite round the Grating ; this Precaution
 “ being taken, the Foundation will be as secure as
 “ any that can be made.

“ The *French* Engineers make Use of another
 “ Method in raising the Foundations of Masonry
 “ under Water, which is, to drive a Row of Piles
 “ round the intended Place, nearer to, or farther
 “ from each other, according as the Water is more
 “ deep or shallow ; these Piles being strongly bound
 “ together in several Places with horizontal Tie-
 “ Beams, serve to support a Row of Dove-Tail Piles
 “ driven within them ; when this is done, and all
 “ well secured according to the Nature of the Situ-
 “ ation and Circumstances, they dig the Foundation
 “ by Means of a Machine with Scoops, invented
 “ for that Purpose, until they come to a solid Bed of
 “ Gravel or Clay ; or if the Bed of the River is of a
 “ soft Consistence to a great Depth, it is dug only
 “ to about 6 Feet, and a Grate of Timber is laid
 “ upon it, which is well secured with Piles driven
 “ into the opposite Corners of each Square, not
 “ minding

“ minding whether they exceed the upper Surface of
 “ the Grate, much or little.

“ When the Foundation is thus prepared, they
 “ make a Kind of Mortar called *Beton*, which con-
 “ sists of twelve Parts of *Pozolano* or *Dutch Terras*,
 “ six of good Sand, nine of unslaked Lime the best
 “ that can be had, thirteen of Stone Splinters, not
 “ exceeding the Bigness of an Egg, and three Parts
 “ of Tile-Dust, or Cinders, or else Scales of Iron
 “ out of a Forge: This being well worked together
 “ must be left standing for about 24 hours, or till it
 “ becomes so hard as not to be separated without a
 “ Pick-axe.

“ This Mortar being thus prepared, they throw
 “ into the Coffer a Bed of ruble Stone not very large
 “ and spread them all over the Bottom as nearly
 “ level as they can; then they sink a Box full of
 “ this hard Mortar, broken into Pieces, till it comes
 “ within a little of the Bottom. The Box is so con-
 “ trived as to be overfet or turned upside down at
 “ any Depth, which being done, the Pieces of
 “ Mortar soften and so fill up the vacant Spaces
 “ between the Stones; by these Means, they sink
 “ as much of it as will form a Bed of about 12 Inches
 “ deep all over: Then they throw in another Bed
 “ of Stone, and continue alternately to throw one
 “ of Mortar and one of Stone till the Work approa-
 “ ches near the Surface of the Water where it is
 “ levelled, and then the rest is finished with Stones
 “ in the usual Manner.

“ M. *Belidor* says in the second Part of his *Hy-*
 “ *draulics*, Vol. II. Page 188, That M. *Milet de*
 “ *Montville* having filled a Coffer, containing 27
 “ Cubic Feet, with Masonry made of this Mortar,
 “ and sunk it into the Sea, it was there left standing
 “ for two Months, and when it was taken out again
 “ it was harder than Stone itself. Where such Mor-

“ tar can be made, this Method has certainly the
 “ Advantage over all the others, not only in Build-
 “ ing the Piers of Bridges over deep Rivers, but
 “ likewise for making Piers for Harbours, and in all
 “ other Aquatic Works : But before it is made use
 “ of, I would advise the Engineer to make first a
 “ Trial of his Mortar; since Works of this Nature
 “ are of too great Consequence to be carried on with-
 “ out an absolute Certainty of Success.

C A S E 3.

“ We have hitherto mentioned such Situations
 “ only where the Ground is of a soft Nature; but
 “ where it is rocky and uneven all the former Me-
 “ thods prove uneffectual; nor indeed has there yet
 “ been any one proposed that I know of, which
 “ might be used upon such an Occasion, especially in
 “ a great Depth of Water; but as an Engineer
 “ ought to know how to proceed upon all Occasi-
 “ ons, we shall therefore mention some few Obser-
 “ vations under this Head. When the Water is not
 “ so deep but the Uneavenness of the Rock can be
 “ perceived by the Eye, Piles strongly shod with
 “ Iron, may be raised and let fall down by Means
 “ of a Machine, upon the higher Parts, so as to
 “ break them off Piece by Piece, till the Foundati-
 “ on is tolerably even, especially when the Rock is
 “ not very hard; which being done either this or
 “ any other Way that can be thought of, a Coffin is
 “ made without any Bottom, which is let down
 “ and well secured so as not to move from its Place;
 “ to make it sink, heavy Stones should be fixed on
 “ the Outside; then strong Mortar and Stones must
 “ be thrown into it; and if the Foundation is once
 “ brought to a Level, large hewn Stones may be let
 “ down so as to lye flat and even; by these Means
 “ the Work may be carried on quite up to the Sur-
 “ face of the Water.

C A S E

“ But when the Water is so deep, or the Rock so hard as not to be levelled, the Foundation must be founded, so as to get nearly the Risings and Fallings ; then the lower Part of the Coffers must be cut nearly in the same Manner, and the rest finished as before. It must however be observed, that we suppose a Possibility of sinking a Coffer, but where this cannot be done, no Method that I know of will answer ; and therefore I leave it to the Judgement and Knowledge of the Engineer employed upon such an Occasion, in what Manner he is to proceed.”

By the first Case Page 142, it is esteemed impracticable to make a good Foundation in a considerable Depth of Water, where the Ground is so bad as not to be depended on without being piled. In order to make a Foundation where it must be piled, and the Water is fourteen or eighteen Feet deep ; the Place being levelled, drive two Piles at each End, and one Pile about the Middle of each of the Place where the Foundation is to be, as far as they will go ; by this Means you'll know the Length of the Piles, and whether there is any considerable Difference of the Ground ; then prepare Piles and make a Frame or Mould of Timber, whose Inside is made to fit the out Edges of the Platform of Timber you intend to sink to build upon ; sink this Mould with Iron Piles to its under side, like Harrow Teeth about two Feet long, to keep it exactly in the Place where your Pier is to be, which Mould will be a sufficient Guide to drive your outer Piles ; prepare two Mandrels to each Gin of strait grown Oak ; each Mandrel must have a Socket of Iron to fit exactly the Heads of the Piles ; it is easy to confine the Socket upon the Pile Head so as to take it off under Water, when the Pile is drove ; with these Mandrells

Piles may be drove in any common Depth of Water, so as their Heads shall not exceed each other in Height much above a Quarter of an Inch, which is sufficiently true in Practice, as those Pile Heads that are somewhat higher than the others will squeeze into the Platform of Timber that is lain upon them; (I have often seen Timber taken off Piles, and some of the Pile-Heads were squeezed near an Inch into the Timber above them; but this was where the Piles were drove in very hard Ground :) Having every Thing ready, sink the Mould in its proper Place, and drive a Pile into each Corner, to help to keep it in its true Position, Places being made clear of the inside Angles of the Mould for that Purpose.

It must be observed, that the Piles drove in the Angles of the Mould, are to be so thick as to have their Heads made smaller than the Body of the Pile, to admit the Mandrel Socket on it, and the Pile below the Socket to be at least as large as the Outside of the Socket, so that the Socket of the Mandrel do not strike the Mould, when the Pile is drove to its proper Lowness; the same is to be observed all along the Sides of the Mould; but this need not be observed in other Places within the Mould. The Mould being rightly laid, fix a Pile into the Mandrel-Socket, and swing the Mandrel perpendicular in Sheers erected for that Purpose, and direct the Point of the Pile against the Inside of the Mould near an Angle; then move the Top of the Sheers so as to slide the Pile Point along the Side of the Mould, till the Angle stop the Pile Point; then bring the Top of the Mandrel vertical over the fixed Point, and drive the Pile down; previous to this there must be made an exact Mark on the Mandrel to show when the Pile is properly drove down. The first Pile being properly drove, let the Mandrel stand upon it, and drive a small Pile near it till its Head or Top is level with
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the Mark upon the Mandrel, (this Pile will serve to direct the driving of all the other Piles by the Mark upon the Mandrels;) proceed, and drive a Row of Piles quite round the Mould, and you will have the outer Row of Piles finished in the true Form, and size of the Platform that is to lye upon them; then drive as many Piles within these Piles as is necessary; then take up the Mould, and drive a few Piles close to the Outside of the outer Piles, to direct the sinking of the Platform you are to build upon with Coffers, or otherwise. I think more need not be said to make an ingenious Engineer understand how he should proceed to drive Piles under Water, that their Heads shall be sufficiently near a Level.

In order to make a Foundation to a Pier in a great Depth of Water, where there is a strong Current and no Tide (as mentioned in *Case 2. Page 143*) I would in the first Place, sink a Body sufficiently large to turn the Current off the Place where the Work is to be done; if the Bodies of old Ships cannot be had, a Break-water must be made, with an Angle to part the Current; and the Sides of a sufficient Length to keep the Current off the Foundation: It will naturally accrue to an ingenious Man how this Break-Water is to be constructed, sunk, and held fast; wherefore I need only say, the Faces of this Break-Water must flance out pretty much near the Bottom, to divert the encreased Velocity and Weight of the Current, so as the Water doth not gull, and scower the Bed of the River from the Break-Water's Sides and get under it, and do much Damage. By Way of Precaution, I would put a great Quantity of Stones against the Insides of the Faces of the Break-Water; when one Pier is raised above the Water, remove the Break-Water to the next Pier, &c. A Break-Water well fixed, will not only prevent the great Inconveniences the Stream would cause in the Works,

but make the Water somewhat shallower there, especially at the upper End of the Pier ; and a Coffor may be used in the same Manner as if there were little or no Current : As to the Construction of Coffers and the Method of Building in Water with them, I refer the Reader to Mr. *Muller's Practical Fortification*, Page 266.

When the Bed of the River is Rock, as mentioned in *Case 3*, Page 146, and the Water too deep to dry the Rock, and the Rock is very uneven and hard, prepare a large Drill Stock whose End is capable to receive a Number of Drills (each about two Inches square) to form altogether a large Drill of about two Feet square, or more, according to the Depth of the Water, and Length of the Stone, that is to be set in the Place made level by the Drill ; (a Machine being fixed to work this Drill.) Let the Drill down upon the Rock in the Middle of the Spot where the Foundation is to be, and let it stand upon its Face, letting the Top incline which Way it will, and you will discover by its Top whether that Spot is level ; if it is level, the Drill need not be used on that Spot ; but a Stone must be let down, whose End is two Feet square, or the Size of the Drill, and length to reach the Surface of the Water ; then move the Drill a Foot and half or two Feet from that Stone, and in a Line with it, a-cross the Work, and the Drill not standing vertical, work the Drill (at first gently) till it stand vertical ; then take the Drill away and let down a Stone as beforementioned : Continue to do so till you have got a Row of Stones placed a-cross the Pier ; and the two outside Stones of each Row is to make the Breadth of the Pier, and Places must be drilled in the Rock for each of the outside Stones, to have six Inches hold of the Rock or thereabouts ; proceed and place other Rows of Stones in like Manner, about one Foot and Half, or two Feet distant,
from

from the first Row, and from each other, only observe that the Stones which form the Outside of the Pier, are to stand as close to each other as can be, and their Ends let into the Rock about six Inches, as I said before: The Pier being formed as high as the Surface of the Water by this Method, fill the Distances between the Stones with good terras Mortar, and small Stones (it is not in the least material to have the Distances between the Stones equal;) then lay a binding horizontal Course of large thick Stones, let in five or six Inches, and well cramped upon the Tops of the Stones, that stands with their lower Ends upon the Rock in the Bed of the River; you may either spring the Arches from this Course, or raise the Piers higher: The above Description may be too concise for some Capacities, but a Person fit to undertake such Works as are here spoken of, will easily understand it. This Method will answer in both the 3d and 4th Cases; for there is no Rock so hard, at least that I have seen or heard of, but a Drill may be made to pierce it. In this Method there is no need of a Coffer; but in a strong Current a Breakwater must be used.

The Machine to work the Drill I mentioned above, must have four Iron Legs whose Length must be according to the Depth of Water, with a Contrivance to lengthen or shorten any Leg, according to the Unevenness of the Place the Legs stands upon; the Feet of the Legs to stand eight or twelve Feet asunder at the Bottom, according to the Depth of the Water, and about three Feet and an Half asunder at the Top, or Surface of the Water, where they go into a Frame of Wood, whose Top is between four and five Feet above the Surface of the Water, and has a square Opening within, where Lavers are fixed to work the Drill; (in Nature of a ringing Gin to drive Piles, but that Lavers are added to encrease the

the Purchase) and which Openings also directs the placing the Stones exactly upon the Place the Drill has prepared : These large long Stones are placed by a Crane fixed in a Vessel for the Purpose ; where large long Stones cannot be got, several Stones may be put together to answer the Purpose of one large Stone.

As to the Method of sinking a Coffin without a Bottom, and making a Pier within it under-Water with Beton Mortar and small Stones, I must acknowledge I do not well know what to think of it, it appearing to me a precarious Method : I have been employed to demolish aquatic Works built with Beton or Terras-Mortar, and, some Parts were cemented together so as the Mortar grew upon the Face of the Wall one Inch or two Thick, and covered all the Joints of the Stones, so as the Face of the Wall appeared as one Stone ; but again in some Places the Mortar had not this Effect, for the Wall was no better in some Places than if it had been built with good common Mortar, and, I have often experienced that Beton or Terras-Mortar, tho' made by the same Man, took Effect in some Places and in other Places miscarried ; as to their being certain Rules to make Mortar that will in all Cases become hard as Stone, I think there is no such Thing, except a very soft Stone is meant ; indeed (where the Work is kept dry) some Mortar will become hard on the Outside, like a Skin, not much inferior in hardness to some common Stone, but this is occasioned chiefly by being well compacted with the Trowel ; but if it is broke into, but an Inch deep, it will be found nothing near so strong as common Stone ; a small Piece of Mortar may sometimes be found, that being compared to a small Piece of Stone, the Mortar will appear strongest, this may have drawn Men into the Mistake ; and to a meer Theorist it will appear self evident

evident, which considered along with the Desire People have for the Marvellous, and the great Opportunity a Gentleman Theorist has above a Mechanick to propogate a Belief, and that too amongst the upper Class of People, I do not wonder at this Notion gaining almost universal Credit. I would not have the Reader to understand that I think it impossible to find out a Composition that will petrifie, and be hard as a Stone, Nature plainly declares for it; and I have observed Petrification, in several Degrees, both in Clay and Gravel: But I would persuade against a too easy Belief of the Strength of Mortar, I having been upwards of thirty Years conversant in all Sorts of Building with Stone and Mortar; and I have seen Beton and Terras-Mortar made various Ways, and upon Trial, have not discovered any Composition that I would depend upon, to form a Foundation under Water for any Pier, though mixed up with small Splinters of Stones, and thrown into a Coffer upon Beds of Ruble Stone.

Of the Foundations of Piers for Harbours.

I have here, as before, transcribed the most material of what Mr. *Mullar* has collected upon this Head; and subjoyned the practical Methods which I would practice, were I employed to lay Foundations of Piers for Harbours, under Water.

“ The Manner of laying the Foundation in different Depths of Water, and in various Soils, requires particular Methods to be followed: When the Water is very deep, the *French* throw in a great Quantity of Stones at Random, so as to form a much larger Base than would be required upon dry Land; this they continue till within three or four Feet of the Surface of the Water, where they lay the Stones in a regular Manner, till the Foundation is raised above the Water; they then lay

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“ a great Weight of Stones upon it, and let it stand
 “ during the Winter to settle, as likewise to see
 “ whetner it is firm, and resists the Force of the
 “ Waves and Winds ; after that they finish the
 “ Superstructure in the usual Manner.

“ As this Method requires a great Quantity of
 “ Stones, it can be practiced but in a few Places
 “ where Stones are in Plenty, and therefore the
 “ following one is much preferable. A Coffer is
 “ made with Dovetail Piles of about thirty Yards
 “ long, and as wide as the Thickness of the Founda-
 “ tion ought to be ; then the Ground is dug and
 “ levelled in the Manner described in the last Secti-
 “ on ; and the Wall is built with Beton Mortar, as
 “ has been described in the same Section.

“ As soon as the Mortar is tolerably dry, those
 “ Piles at the End of the Wall are drawn out, the
 “ side Rows are continued to about thirty Yards
 “ farther, and the End inclosed, then the Foundati-
 “ on is cleared, and the Stones laid as before. But
 “ it must be observed, that the End of the Founda-
 “ tion finished is left rough, in Order that the
 “ Part next to it may incorporate with it in a proper
 “ Manner ; but if it is not very dry, it will incline
 “ that Way of itself, and bind with the Mortar that
 “ is thrown in next to it ; this Method is continued
 “ till the whole Pier is intirely finished.

“ It must likewise be observed, that the Piers are
 “ not made of one continued solid Wall ; because in
 “ deep Water it would be too expensive ; for which
 “ Reason, two Walls are built parallel to each other,
 “ and the Interval between them is filled up with
 “ Shingle, Chalk and Stone : As these Walls are
 “ in Danger of being thrown out or overfet, by the
 “ Corps in the Middle, together with the great
 “ Weight laid at Times on the Pier, they are tied
 “ together by cross-Walls at every thirty or forty
 “ Yards

“ Yards Distance, by which they will support each other in a firm and strong Manner. For want of these Cross-Walls it has happened, not many Years ago, that the Walls of a Work were over-set for the Space of some hundred Yards.

“ If such Mortar can be made as what the *French* call *Beton*, there can scarcely be found a better Method than that above, for laying Foundations in deep Water, and it may be used upon all Occasions; but as such Mortar is not every where to be had without great Expences, I imagine that common Terras-Mortar, mixt with small Stones and some Cinders, if to be had, will answer the Purpose as well; but the Engineer, who is to carry on the Work, ought to make Trial of it before he uses it.

“ If the Foundation be bad to a great Depth, I would sink it only about four Feet below the Bed of the River; and lay a strong Grate of Timber, as in those of the Piers of a Bridge; but if it should be rocky, a Coffer must be made without a Bottom, and the under Part cut nearly with the same Risings and Fallings, according to the Manner mentioned in the last Section.

“ In a Country where there is a great Plenty of Stones, Piles may be driven in as deep as they will go, at about two or three Feet Distance, and when the Foundation is sunk and levelled, large Stones may be let down, which will bed themselves; but Care must be taken to lay them close, and so as to have no two Joints over each other, and when the Wall is come within Reach, the Stones must be cramp'd together.

“ Another Method practiced, is to build in Coffers, much after the same Manner as has been done in Building the Piers of *Westminster-Bridge*; but as in this Case the Ends of the Coffers are left

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“ in the Wall, and prevent their Joining so well as
 “ to be Water-Tight, the Water that penetrates
 “ through and enters into the Corps, may occasion
 “ the Wall to burst and tumble down. Another In-
 “ conveniency arising from this Manner of Building
 “ is, that as there are but few Places without
 “ Worms, which will destroy Wood wherever they
 “ can find it ; by their Means the Water is let into
 “ the Pier, and consequently makes the Work liable
 “ to the same Accident as has been mentioned
 “ above.

“ To prevent the Inconveniences of this Method,
 “ I would take the Wood away, and joggle the
 “ Ends of the Wall together with large Stones, and
 “ pour Terras-Mortar into the Joints ; when this is
 “ done, the Water between the two Walls may be
 “ pump'd out, and the void Space filled up with
 “ Stone and Shingle as usual : Or if these Joggles
 “ cannot be made Water-tight, some Dove-Tail
 “ Piles must be driven at each End as close to the
 “ Wall as can be done, and a strong sail-Cloth put
 “ on the Outside of them, which, where the Water
 “ is pumped out, will stick so close to the Piles and
 “ Wall, that no Water can come in. This Method
 “ is commonly used in *Russia*, as I have been inform-
 “ ed.”

Before an Engineer forms his Method of proceeding in Foundations, it is absolutely necessary he know the Depth of Water, the Nature of the Ground, and what Materials he has to use, and what Trouble he is like to meet with from the Agitation of the Water ; whether the Seas run square or oblique to the Direction the Pier is to be built in, &c.

Admit a Pier is to be built in Water twenty Feet deep, and the Ground is soft, prepare a Machine that will lower any Weight under forty Tuns ; and when the Pier is carried out from the Shore to
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where the Water is too deep to build any farther in the common Manner, make the End of the Pier slope, or fall back about one Foot and an Half in every two Feet in height, then place your Machine fair to this Slope, in order to lower a Pile of Masonry, which is to slide down against the sloping End of the Pier, till it stand upon the Ground (at the Bottom of the Water.) It is to be observed that this Pile of Masonry is to lay Part of its Weight against the sloping End of the Pier; as well as upon the Bottom, I think every Pile of Masonry may add three Feet to the Length of one Side of the Pier, and another such Pile of Masonry, add three Feet of Length to the other Side of the Pier; and each Pile of Masonry make ten Feet Thickness of Pier at the Bottom, and five Feet at the Top, or Surface of the Water, (where a new Foundation about ten or twelve Feet broad must be made on each Side upon the Tops of those sunk Piers of Masonry;) *i. e.* Every Pile of Masonry sunk for a Foundation, to be three Feet thick, ten Feet long at the Bottom, and five Feet long at the Top, and as high as the Water is deep, which here is supposed twenty Feet. This Pile of Masonry with the Timber under it, supposing sixteen cube Feet to a Tun, will weigh near Twenty Eight Tuns: It is easy to fasten Hooks to the Bottom of the Piles (to lower it) that may be hawled loose when the Pile is at the Bottom; I would have thick Pieces of Timber put a-cross under the forepart of the Timber that is under each Pile of Masonry, to keep the forepart of the Work well up.

When Pieces of Timber are put upon the Bottom of the Frame (if necessary to make it fit the Ground; but the Bottom of the Pile covers so little Ground, the Ground must be very uneven to require levelling) and every Thing is ready, fix the Frame of Timber on the Hooks, and place its Edge to the

Top

Top of the Slope, against which it is to be lowered to slide down to the Bottom. When one Course of Stone is laid, lower it till the upper Side of that Course is a proper Height to receive another Course upon it, and so continue to lower the Pile of Masonry into the Water, as you build it ; (the Friction in sliding down against the sloping Stone-Work, and what the Water bears, will take off a considerable Quantity of Weight.) Care must be taken to lower it equally, and which ever End touches the Ground first, that Chain or Rope must be slackened away, and the other held fast, till that End of the Pile is sunk into the Ground as far as it will ; a Row of Dove tail Piles must be driven along each Side of the Pier by Mandrils, in the Manner mentioned before, *Page 148*, where the Foundations of Bridge-Piers are treated of.

I have said the Piles of Masonry are to make ten Feet Thickness of Pier at the Bottom, on each Side, but I would not have the Reader understand that the Timber under the Masonry should be only ten Feet long, I would have the Timber under the Piers of Masonry about eighteen Feet long, and a cross-Piece of Timber strongly fastened upon the upper Part, near the Ends of the Balks, that the Rubble Stone, or other Matter that makes the middle Part of the Pier, may lie heavy upon the inner Ends of the Timber, and in some Measure secure the Foundation from slipping forward ; (as necessary Helps will occur to every ingenious Man.) It is scarce worth mentioning that I would lay a large Hull of an old Ship, or two, before the Work, to keep the Water smooth when it is working Weather ; but when the Water is much agitated (and the Foundation is in the Sea) the Foundation cannot be worked at.

To sink or dig a Foundation for an Harbour-Pier three, four, or six Feet below the Surface of the Ground, in six or eight Feet or more Depth of Water, must be attended with a more considerable Expence than two Rows of Dove-tail Piles; and I think two good Rows of Dove-Tail Piles, are a greater security to the Foundation, than its being laid three or four Feet below the Surface of the Ground; for the Digging a Foundation below the Surface, can answer only two Purposes for the Good of the Pier, *i. e.* prevent the Water from undermining the Pier, and hinder the Foundation from sliding from its Place, both which Purposes will be answered as well, by driving a good Row of Dove-Tail Piles on each Side the Fortification; and in the Case of preventing the Water undermining the Pier, will answer better: As to the Ground bearing the Pier better, when the Foundation is let three or four Feet into it, is little better than a superficial Piece of understanding; for, Pier Foundations are generally considerably broader than the Height of the Pier, and some Piers are twice as broad as high: The Ground is very soft indeed that will not bear a Wall whose Base or Foundation is about 40 Feet broad, and Height only about 25 Feet at most; I therefore conclude, That the principal in laying Foundations of Harbour-Piers, is, to secure the Foundations from being undermined by the Water. This Method of sinking Stone-Piers, can only be practiced where Plenty of good Stones can be had.

I have dwelt the longer upon this Head, because I have seen great Expence bestowed in Foundations which might have been saved, without any Prejudice to the Building: I beg leave to mention one Case:

Upwards of thirty Years ago, I was employed as a Workman, in Building a Stone Pier, which Pier is about forty-two Feet thick at Bottom, and about twenty

twenty Feet high, and stands upon very hard stony Ground ; the Engineer ordered five Rows of Piles to be driven under the Foundation, on each Side the Piers, near the Fronts, and about two Feet apart, and Oak Sleepers (at first) from fourteen to twenty Inches broad, laid Lengthways upon the Heads of those ten Rows of Piles ; the Space between the Sleepers were well filled with flat large Stones ; then strong Balks from fifteen to twenty Feet long, laid on each Side the Pier, close together (like a Platform) crosswise upon the Sleepers, and well tree-nailed down to the Sleepers : Little or nothing more could be done, save driving two Rows of Dove-Tail Piles, and binding the Timber together in the Middle, to have a Foundation upon the softest Ground that ever was built upon.

There was more than double the Expence bestowed, that would make a sufficient Foundation upon that Ground, and yet this Foundation, notwithstanding all the Expence, was not sufficient, as has appeared since ; for the front Piles, as well as the others, stood about two Feet apart, some more, some a little less ; and when the Channel by the Pier scowered deep, the Stream being very strong, and getting in among the Piles, where meeting Obstructions, scowered away the Ground and Piles, and a Part of the Pier, fell into the River ; for many of the Piles (tho' well shod with Iron) bruised below, and had not drove three Feet. The Ground is very strong, but very Subject to scower away, being a Body of great and small Stones, but chiefly Stones like Pebbles, made solid by Sand and Gravel being washed in amongst them, so that it formed a Body almost as strong as Rock to bear a Burthen, but easily undermined by a strong Stream ; so the only Care required was to keep the Stream from getting under the Pier, which a single Row of good Piles driven

close

close together along the Foreside of the Pier would affected; and as there was Plenty of excellent flat broad Stones to lay the Foundation, there was no need of a strong Platform of Timber.

Some Years after, I had the Direction of making a Foundation upon the same Ground, and adjoining this Foundation abovementioned; and because I did not drive Rows of Piles under the Pier, as above, a Person, who pretended to be an Engineer, advised my Principals I was making an insufficient Foundation, (tho' I had drove a Row of Piles close to each other along the Front of the Pier, so that the Pier could not be undermined there by any Force of Water;) but when I had given my Reasons, for saving so much Expence, the Majority of my Principals were on my Side, and the Work went forward.

I have inserted this Account, with an Intent to persuade whom it concerns, not to trust to any one who pretends to be an Engineer, but make a strict Enquiry into his Character as an Engineer, especially in Places where he has been employed; and as most Men have two Characters, do not believe the first Account of him till you have had several Accounts: And as there are some who thro' Favour jump into a Character, if there are several Engineers of good Character, chuse him who has had the greatest and longest Practice; for there are but few Men who are capable to judge of an Engineer's Abilities, and consequently but few who can give a true Character of him.

If a Pier is to be built where the Bottom is Rock, and the Rocks very uneven at the Top, and the Depth of the Water from three Feet deep to twenty; the high Tops of the Rocks may be lowered by Drills, as mentioned in *Page 150* (where the Foundations of Bridge-Piers treated of;) but it will be

be impracticable, as well as unnecessary, to make the whole Bottom level by Drills, or otherways; for the Bottom, where every single Piece of Masonry is to be placed, need only to be made level singly one after another; for which Purpose they must be founded, and the Platform of Timber made to fit the Bottom of each as near as possible, which is the more practicable as every Piece of Masonry covers only about three Feet of Foundation lengthways; so that one Piece of Masonry may stand upon a high Place, and the next let down to a lower Place, if it so happen: The greatest Difficulty is to make the Pieces of Masonry find a proper Seat in the Crossway in the Pier, from the Front inward; but the Pieces of Masonry being a considerable Length cross-ways, the Bottom may be founded, and the highest Places lowered by a Drill or otherwise; and a Body of Timber prepared and sunk under the Masonry, that will make a Bed level enough for the Masonry to lye upon.

If a Pier must be built in eight or ten Feet Water, and Stones can be had any Length to twelve or thirteen Feet; I would as before, see *Page 156*, make a proper Slope, and slip the Stones down to the Bottom one upon another, not too upright, nor too much reclining, but lying a sufficient Weight upon the Stones undermost; (if Stones cannot be had of one Length to reach the Bottom, two may be cramped together to answer the Purpose) with a Groove on the upper Bed of each Stone, to receive Toggals let into the under Bed of each succeeding Stone; so that the Toggals will slide down the Grooves, and keep each Stone fast in its Position; the upper Ends to be made to lye well back from the Front, that the Material put into the Middle of the Pier do not force them forward. Upon the upper Ends of these Stones must be laid strong binding Courses a-cross the Pier, to keep

keep the Pier together; and a Row of Dove-tail Piles must be driven on each Side the Foundation, to keep the Sea from undermining the Pier.

When Stones cannot be had without too great Expence, make Bricks 15 Inches long, $7\frac{1}{2}$ Inches broad, and $2\frac{1}{2}$ thick when burned; put two, $2\frac{1}{2}$, three or more of these Bricks together, with the strongest Mortar, and let them be thoroughly dried before you use them; with these Bodies of Bricks, make Pieces of Masonry, and sink them as directed before in sinking Stone Piers, or Pieces of Masonry, *Page 159*. But a Difficulty will arise in lowering the Brick Piers the upper Part of the Side next the Slope it slides down against, will lift up by the Friction more than large Stones, To prevent this, put two hard Oak Boards against the Slope; one near the Forepart, and one near the Back Part to slide down with the Pier; the Space between these Brick Piers occasioned by the Oak Boards, to be filled up by the running Terras-mortar and small Stones into it: If Worms destroy the Boards, the Terras-Mortar will keep the Work firm.

It might prove very useful to young Practitioners, if the minute Actions, in the Execution of Schemes for Foundations, &c. were explained: For the executing such Schemes are the most difficult Part; it being easy to say do this, or do that; and the scheming Theorist would generally make a poor Figure, were his Plans to be executed in all its material and minute Parts by his particular Orders. But, to explain all the minute Actions necessary in the practical Part, exceeds my present Design; I not having time to spare for such a Work.

C H A P. VI.

Of the Length of Arch-Stone.

AS there are no Rules, I know of, that determine the Length of Arch-Stones, proportional to the different Spans or Widths of Arches, I will give the Reader what I have gathered from Practice and Observation upon this Head; but it may be proper, first, to give an Account of what M. *Belidor*, an eminent *French* Engineer, and M. *Gautier*, have said on this Subject, as collected by M. *Mullar*, who says in his *Practical Fortification*, Page 253, as follows :

“ The Thickness of Arch-Stones, I must confess, is not to be determined by Theory, at least that I know of ; nor do those Authors who have written on the Subject agree among themselves. M. *Gautier*, an experienced Engineer, in his Works, makes the length of the Arch-Stones, of an Arch 24 Feet wide, 2 Feet ; of an Arch 45, 60, 75, 90 wide, to be 3, 4, 5, 6 Feet long respectively ; when they are hard and durable, and something longer when they are of a soft Nature. On the contrary, M. *Belidor* says they ought to be always one Twenty-fourth Part of the Width of the Arch, whether the Stone be hard or soft ; because, if they are soft, they weigh not so much. But that the Length of the Arch-Stones should be but a Foot in an Arch of 24 Feet wide, 2, 3, 4, in Arches of 48, 72, 96 Feet, it appears to be impossible ; because the great Weight of the Arches would, as I imagine, crush them to Pieces, by the Pressure against one another ; and therefore M. *Gautier*’s Rule seems to be much preferable : As he made the Length of the Arch

“ Stone

" Stone to encrease in a slower Proportion, from 10
 " to 45 Feet wide, than in those above that Width,
 " whether they are great or little: Therefore in the
 " following Computation, we shall suppose the
 " Length of the Arch Stones of 30 Feet in width
 " to be two Feet, and to increase one Foot in fifteen,
 " that is 3 Feet in an Arch of 45 Feet, 4, 5, 6 in
 " an Arch of 60, 75, and 90 Feet; and so the rest
 " in the same Proportion."

The most useful Knowledge, in any Action where
 Expences are required, is, to know how to bring
 the Affair to a good Conclusion with the least Ex-
 pence; and he is the best Artist in Building that is
 capable of erecting a House, Fort, Bridge, &c.
 that will answer the End for which it is built, with-
 out any unnecessary Expence; but such a Man must
 not only have a good Genius, but be also a thorough
 Practitioner both in Practice and Theory: There are
 few such Men compared to the great Number that
 know only a little of each, and yet are often intrus-
 ted with Works of the greatest Consequence; so that
 it is more than twenty to one against your happen-
 ing to get a Person that can execute a Work with the
 least Expence, to answer the End proposed.

I have observed the different Extremes, and Ex-
 pence misapplied in many Places; and it will gene-
 rally be so till Men of Fortune and Interest take the
 Trouble to qualify themselves to discover and encour-
 age Men of proper Talents.

It appears to me the length of Arch-Stones de-
 pends on too many Circumstances to fix any certain
 Rule to go by; for, a half Circle Arch doth not re-
 quire so great a Length of Arch-Stone, as a Seg-
 ment Arch of equal Span or Width; and the flatter
 Arches are, the longer Arch-Stones they require in
 Proportion to their Width; and the great Difference
 in the Quality of Stone and Mortar, may induce a

good Judge to make the Arch Stones a little shorter, or longer; and if an Arch has more rise or pitch than half its width, as some Gothick Arches have, such Arches or Openings may be made with Spannerals, without Arch Stones, see *Fig. 2. in Plate IX.* which would save the Expence of the Center.

I made an Arch in *Sunderland Pier*, of 40 Feet 8 Inches wide between the Springers. The Archstones are, in general, only one Foot three Inches long; but, the Arch Stones that make the Face of the Arch or Pier, are irregular Lengths; the shortest is one Foot eleven Inches long. This Arch is built chiefly without Mortar, and Works are not yet built, as intended, to keep the Sea from beating against it; and yet there is no Danger of the Arch falling: Indeed there is no heavy Carriages goes over this Arch.

There is a Bridge (of two Segment Circle Arches) over the River *Wear*, at *Bishop-Auckland*, in the County of *Durham*, whose North Arch is 100 Feet 5 Inches wide, its rise 22 Feet; Here is three Arches laid one upon another; but the uppermost appears a very bad Arch, being irregular Stones, as if built only to help to support the Battlement; the first and undermost Arch is 14 Feet 6 Inches broad; the 2d Arch lies over the Arch under it near 3 Inches on each Side; the third and uppermost Arch sets over the second Arch in like Manner; and the Battlement also sets over about three Inches; thus about eight or nine Inches breadth on each side is gained, to make more Room for Passage on the Bridge. The Length of the Arch Stones of this Arch (of 100 Feet, 5 Inches wide) is no more than two Feet, and the Stones of the First Arch doth not appear to have hold of, or even Connection with the second Arch, which is turned close upon it; but as the Stones of the first Arch appears longest at the Crown, or Middle of that Arch, and as there appears a considerable

able wide Joint of Mortar, between the Crown of the first Arch, and the underside of the second or Counter Arch over it, I am induced to believe the Crown of the lower Arch has come down an Inch or more from the Arch above it; and that low Arch hangs by its Abutments clear and independant of the Arch above it, (tho' the Arch Stones are only two Feet long, and the Arch 100 Feet 5 Inches wide, and rises but 22 Feet, as I said before;) which with the bad irregular Arch over that again, supports the Superstructure, and the Weight of Carriages that go along the Bridge.

The South Arch is 91 Feet 5 Inches wide, and 20 Feet Rise or Pitch, with 3 Arches one over another, in every Respect as the North Arch, save that the Arch Stones is only one Foot ten Inches long. I measured the Length of these Arch Stones, but the Length of the North Arch Stones was given me, and as I could not discern (tho' I stood very near) the North Arch-stones, to be longer than the South Arch Stones, I am satisfied the Measure is right; the Crown of this lower Arch, has also dropped from those above it, about an Inch, and hangs independantly between its Abutments; the second, or counter Arch, assisted by the third Arch, bears the Superstructure. This third Arch appears a much better Arch than the North third Arch; the Arch Stones in all the three Arches are near of a Length.

The Pier between the Arches is 19 Feet 5 Inches thick, and built in the usual Manner; the upper Part of this Bridge is of very irregular bad Stones, the whole Breadth on the Top Battlements included, is no more than 15 Feet 10 Inches.

This Bridge was built by *Wilfre* or *Wilfred Skirley* in 1338.

I could mention other Bridges, whose Arches appeared to me so very slender, that I would not, 20
Years

Years ago, ventured along them, if I had not known Carriages, &c. had gone over before me; and I believe there are very few Instances of Arches failing, but there was some other Defect than the Arch Stones being too short; and with Respect to M. *Belidor's* and M. *Gautier's* Rules for determining the Length of Arch-Stones, I cannot help thinking that better Rules may be found, for, M. *Belidor's* Rules for the Length of Arch Stones, is one twenty fourth of the Width of the Arch, but by this Rule, the Arch Stones in small Arches, *i. e.* from ten Feet wide to thirty, would be too short to bear heavy Carriages; for the Arch Stones in an Arch of wte Feet wide, would only be five Inches; and nteny Feet wide ten Inches; and in an Arch of thirty Feet wide fifteen Inches, &c But from forty Feet width to eighty five, M. *Belidor's* Rule will do indifferently well; and from eighty five upwards, one Twenty fourth Part of the Width of the Arch makes the Arch Stones too long. See the following Table.

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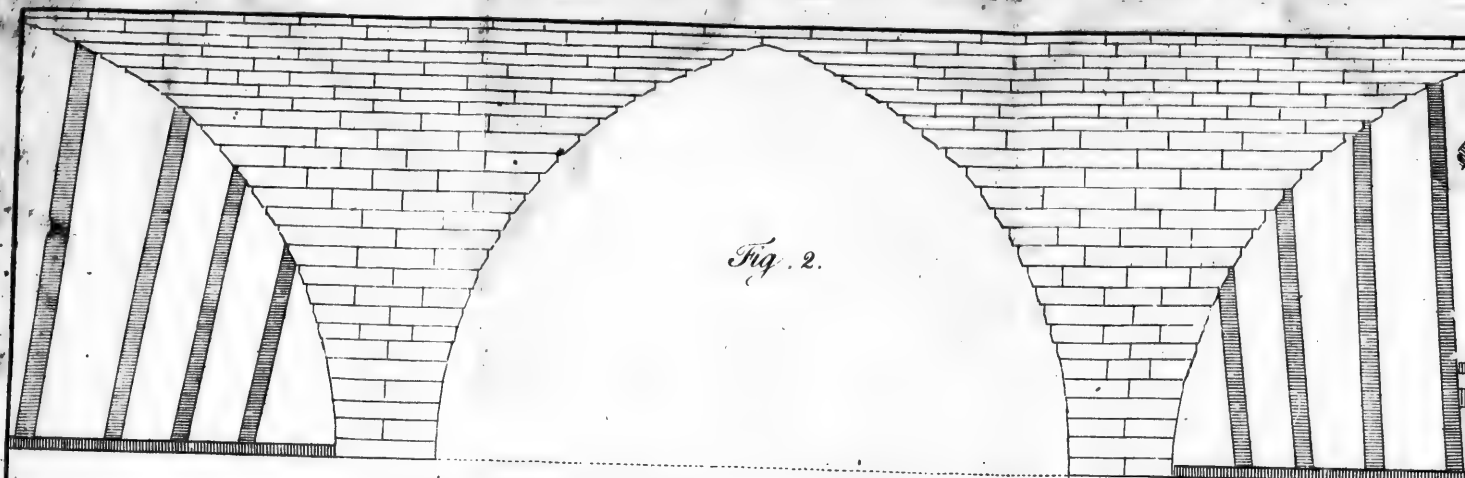
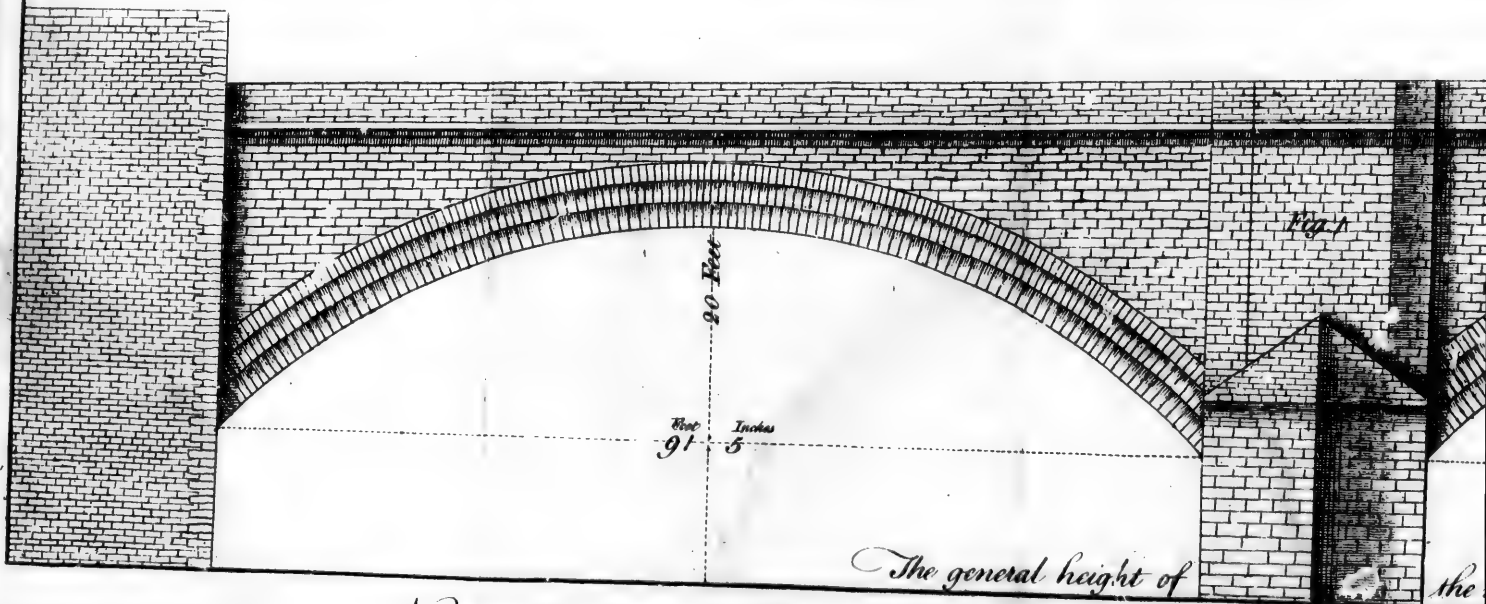
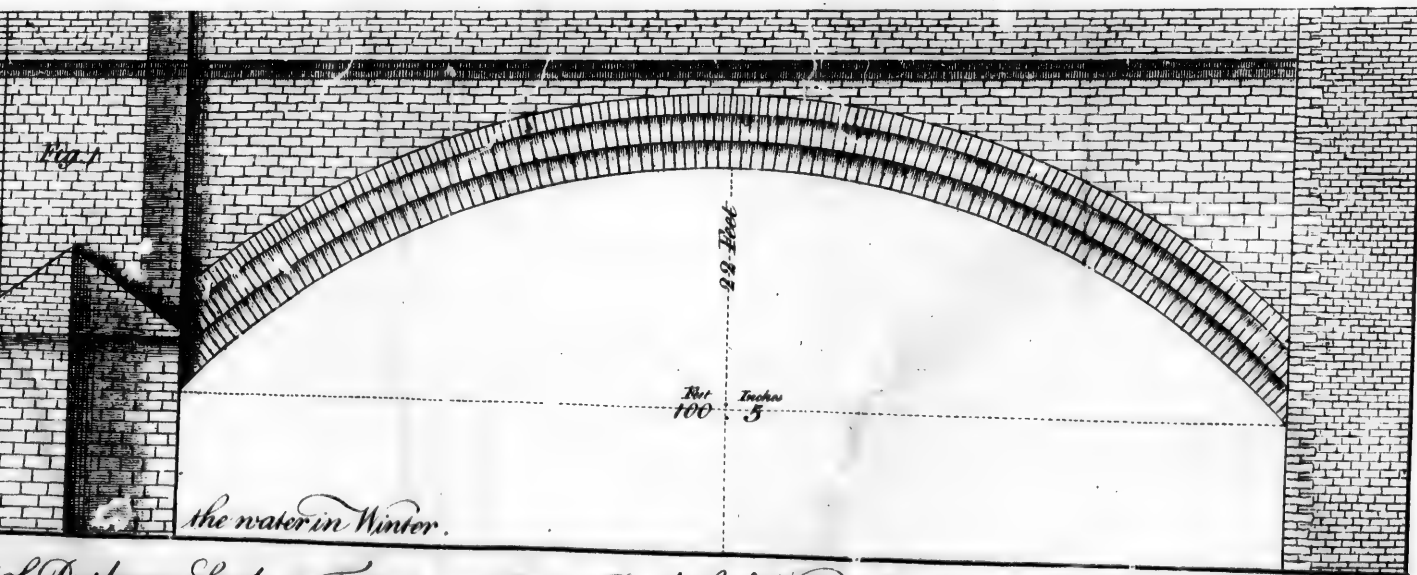
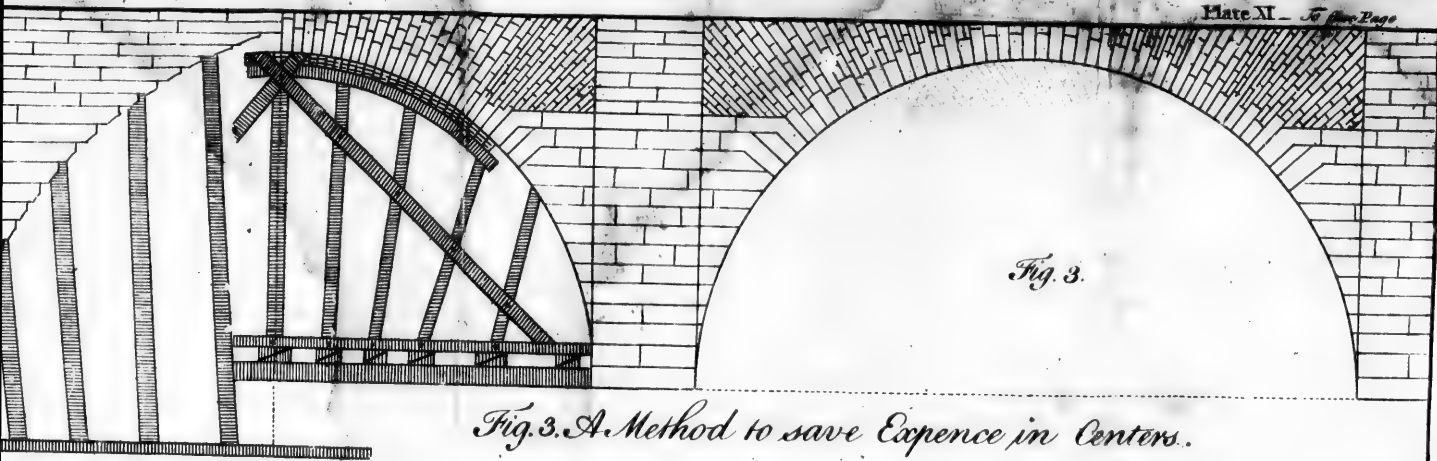


Fig. 2. To build Bridges without Centers.



*The general height of
Newton Bridge near Bishop Auckland in the County of Durham, Sea*



of Durham, Scale 15 Feet in an Inch. Built by Wilfr. Shirley/1388.

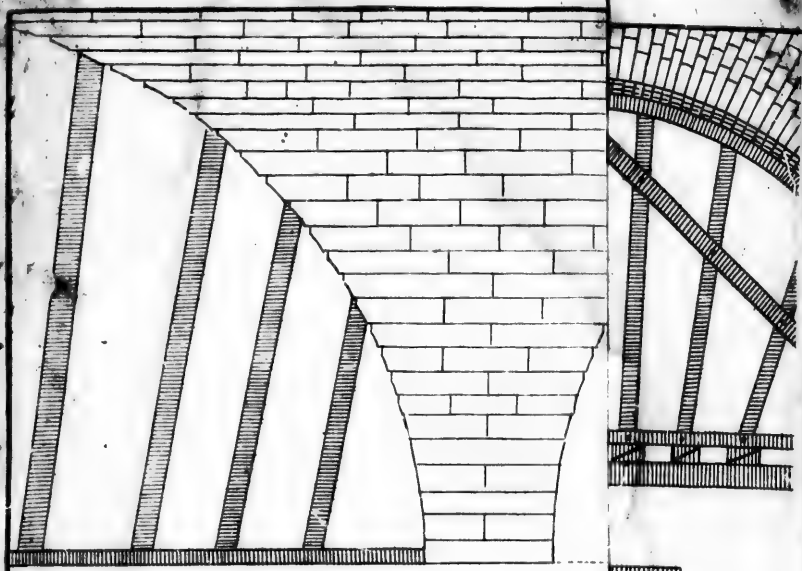
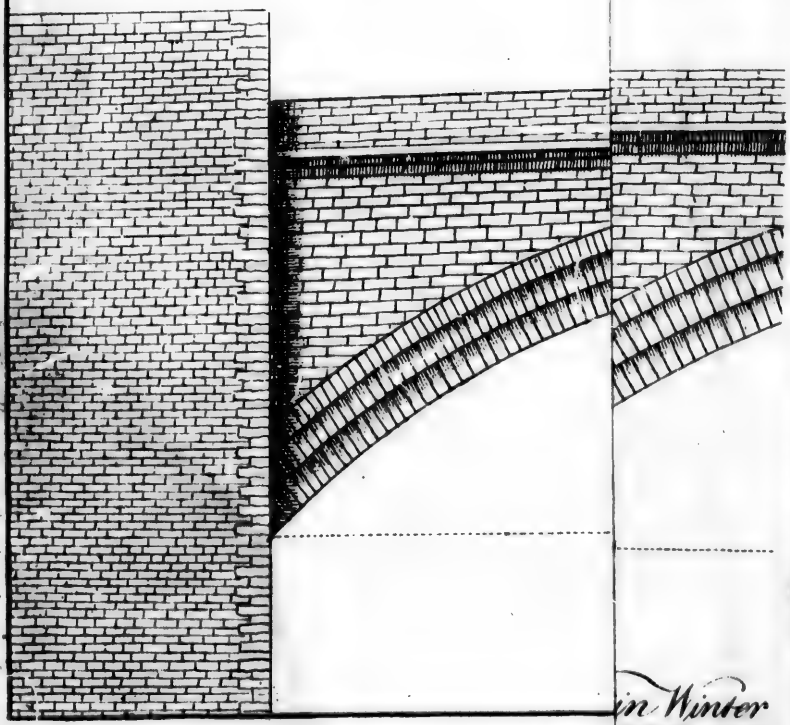


Fig. 2.



in Winter
New Feet in a

A TABLE shewing the Length of Arch Stones
for Circular Arches to bear heavy Carriages,
from 10 Feet width to 120.

Width of the Arch in Feet.	Part of the Width of the Arch.	Length of the Arch Stones in Feet and Inches.
		F. I.
10	$\frac{1}{10}$	or 1 0
15	$\frac{1}{12}$	or 1 3
20	$\frac{1}{14}$	or 1 5
25	$\frac{1}{16}$	or 1 0
30	$\frac{1}{17}$	or 1 9
35	$\frac{1}{18}$	or 1 11
40	$\frac{1}{19}$	or 2 1
45	$\frac{1}{20}$	or 2 3
50	$\frac{1}{20}$	or 2 5
55	$\frac{1}{21}$	or 2 7
60	$\frac{1}{22}$	or 2 9
65	$\frac{1}{22}$	or 2 11
70	$\frac{1}{23}$	or 3 1
75	$\frac{1}{23}$	or 3 3
80	$\frac{1}{23}$	or 3 5
85	$\frac{1}{24}$	or 3 6
90	$\frac{1}{23}$	or 3 7
95	$\frac{1}{23}$	or 3 8
100	$\frac{1}{23}$	or 3 9
105	—	3 10
110	—	3 11
115	—	4 0
120	—	4 1

These Arch Stones are of a sufficient Length,
especially where there is good Mortar and good flat
rough Stones to form a Counter Arch, to keep the
Shaking of heavy Carriages from the Arch below,
and as a good Thickness of Mortar and rough
Stones, are, or ought to be, generally laid upon
the

the Crown of every Arch. It may be ordered so that the rough Masonry upon the Arch shall, when dry, form almost as strong an Arch, as that below it, and the Difference of Labour in building the rough Masonry archways, is scarce worth mentioning.

As to *M. Gautier's Rule*, it makes the Arch-Stones much too long, as is plainly demonstrated by all the Arches I have seen, and in particular by the Bridge at *Bishop-Auckland*, in the County of *Durham*, above mentioned, the Arch Stones in the Arch thereof 91 Feet 5 Inches wide, is no more than one Foot ten Inches long, which by *M. Gautier's Rule* should be six Feet long, besides the Expence such an Arch will cost, it will require a large Quantity of Timber to make a Center to support so great a Weight, such an Arch as this will be very expensive without a Necessity; for if the Length of the Arch Stones are only sufficient to support its own Weight, and a Quarter more, by building upon this Arch in the Manner above mentioned, will make the Bridge sufficiently strong to answer the End.

CHAP VII.

THE Art of making Rivers, Creeks, Harbours, &c. more safe and commodious for receiving Ships and other Vessels, and the making the best Use of the Fluxes of the Sea towards making Rivers navigable, as far up within the Land as possible, and to get a strong Reflux to keep Rivers Mouths clear of Obstruction, is an Art of considerable Consequence in many Places of *Europe*, especially in some Places of *Britain*; therefore I will endeavour to clear up a Point or two; the acting upon the wrong Side of which, has been very injurious to the Navigation of many Rivers and Harbours

bours, and the Cause of several useful Harbours being entirely lost.

The first Point in Question I shall examine, is, whether large Receivers in Rivers a Mile or two or more or less up the River from the Sea, (such as *Farrows Lake* in the River *Tyne*,) doth, or doth not cause the Flux of Water to come into Rivers with greater Force than if the Rivers were nearly of a Breadth, from the Sea to the End of the Flux. In order to set this Point in as fair a Light as I can, I will imagine two Rivers of equal Breadth and Depth, from the Sea for a Mile up within the Land, so that the Entrance of each River will admit an equal Quantity of Water, and each River has the same Turnings, and upon a Level ten or twelve Miles up; but one of them is no wider than at its Entrance all the Way up to the End of the Flux; and the other River from about a Mile from the Sea, is very broad, and continues broad for a Mile or two further upward; and then narrows to near the same Breadth of the other River; and the Flux of the Sea rising to the same Height at the Mouth of each River, I think I may venture to say, it is natural to conclude that more Water will go into the River that has the greatest Receiver; and the Stream will run into and out of that River with greater Swift-ness and greater Force, than it will run into and out of the River that hath the small Receiver.

Tho' I think the Conclusion I just now made is self-evident, but, by way of Illustration, give me Leave to suppose two Tubes of equal Dimensions, (each three Inches broad, and eighteen Inches high) placed for Water to run through them, to fill two Spaces each eighteen Inches deep, which is the Height of the Tubes or Openings, and one hundred Feet long, more or less; but one Space or Receiver to be three Times as broad as the other, and consequently

frequently will hold three times as much Water. Having Things properly fixed, make a Body of Water, like the Flowing of the Sea, come gradually against and run through these Openings, to fill the Spaces or Receivers (mentioned above;) and I make no Doubt (when the Spaces or Receivers is about $\frac{3}{4}$ full) but there will be a perceptible Difference between the Streams in the two Receivers, flowing at the further Ends above the Level of the Openings where the Water comes in, or what we may call the Sea: And the Stream in the large Receiver, or larger River, will when the Receiver or River is $\frac{3}{4}$ full, rise more above the Level in the Receiver at the further End, than the Stream in the small River or Receiver. This is the second Point to be proved; and if the Water is raised gradually (like the flowing of the Sea) to the Tops of the Openings, both Receivers or Rivers will be filled to the same Height, by the same Flow of Water without; tho' one holds three Times as much Water as the other, consequently the Water must run with three Times the Velocity in at the Openings that is to fill the great Receiver, or River, than it doth in at the Opening that fills the small Receiver or River; and if you let the Water come out again at these Openings, by making the Water without recede, like the Ebbing of the Sea, it will run out at the Opening in the large Receiver or River, with much more Force than from the Opening to the small Receiver; and is the third Point to be proved, which I think must appear evident to every one that knows any Thing of the Nature of Fluids.

The Reason of large Receivers, or large Rivers, being filled to the same Height, that small Rivers or Receivers is filled to with the Flux of the Sea, through Openings or Inlets of equal Dimensions, are, The small Receivers or Rivers, fill faster than the large Receivers or Rivers, till near high Water without;

without ; by which the Velocity of the Water, thro' the Inlet to the small Receivers, is retarded that it cannot run into the small Rivers or Receivers, so fast as into the great Rivers or Receivers ; and the Sea when flow'd to its Height, keeps up at its Height a sufficient Time for large Receivers to take in much Water after the small Receivers or Rivers are full, consequently the Streams doth run with a considerable Force a considerable time into the large Receivers, after it has done running, or runs but very slowly, into the small ones.

The Reader, I imagine, is now of Opinion that the Tides run with greater Velocity into those Rivers that have large Receivers, than into the Rivers that have small Receivers. The Entrance being of equal Depth and Breadth, and consequently the enlarging or lessening the Receptacle for Water in a River, augments or diminishes the Force of the Stream into that River. This Maxim in Hydraulics, I think, is clear and well founded : This is the first Point I propos'd to examine ; and have in few Words set it in as fair a Light as I can.

It now being evident, and I suppose acknowledged, that the larger a Receiver is in a River, the Stream will come into that River with a proportional greater Force. This being admitted, it cannot be denied, that,

The large Receivers in Rivers, are also the Cause of the Stream running farther up the River than it would do if the Receivers are much lessened, or quite filled up. This is plainly proved, by the Tides not running so far up the Rivers, after the Receivers have been lessened, as has been attested by several who have taken Notice of these Matters : An old Man, of good Credit, said he learned at a School near the River *Tyne*, and he, when a Boy, often saw the Tide cover a particular large Stone
that

that lay in the River, near where they used to play ; but now the Tide doth not flow up so far by about a Mile and an Half. And a Gentleman who lives upon the River *Wear*, in the Neighbourhood of *New-Bridge*, affirmed in my Hearing, that he, when a Boy, saw Straw driven upward through *New-Bridge*, with the Tide ; and now the Tide doth not flow so high at *New-Bridge* by about two Feet perpendicular ; and I know the Receiver of the River *Wear* has been much lessened, and many Keys built in the River since that time. Here it may be replied, The Sea may, in sixty Years, have receded from the Shore so much where the *Tyne* and *Wear* are, as to cause the Difference of the Tides up these Rivers here mentioned. I know the Sea has receded from Shores which I have seen ; but as I never heard that any Person has taken Notice of any such Difference of the Tide in *Shields* or *Sunderland* Harbour ; and there being no Token nor visible Marks to be seen at either Place, whereon to ground the least Suspicion of such Difference of Tides in these Harbours, it may be said without Fear of Contradiction (that is founded in reason) that the Tides now not flowing so high up the *Tyne* and *Wear*, is entirely owing to building Keys, and lessening the Receptacles in these Rivers. This is the second Point I proposed to examine ; and it is evident that the Water runs farthest up the Sand, on the Sea Shore, and in greater Quantities when the Waves push it with the greatest Force ; and it is also evident a Ball will run farthest up a Hill, and return back with the greatest Force, when thrown up a Hill with the greatest Velocity : So will the Water run strongest into, and out of those Rivers that have the largest Receivers. This is the second and third Points with respect to the Utility of large Receivers in Rivers, proposed to be examined. These foregoing Maxims being

being clear and evident, it must be highly criminal to fill up the Receivers in a River, or Stop the Tide from flowing up a River, by Building Dams, &c. especially in Rivers where the Tide did not, before such Encroachments, flow far enough up for the Trade carried on in that River, nor the Reflux sufficiently strong, before such Encroachments was made, to keep the River's Mouth effectually open, for Ships to sail out and into the Harbour. I think more need not to be said to prove that the filling up the Receivers in Rivers, both stops the Stream of the Tide from getting so far up inland as to enable small Craft to Trade better up and down the River ; and also deprives the River of its antient necessary Stock of back Water, which is absolutely requisite, and was not antiently quite sufficient, and must be less sufficient to keep the River's Mouth sufficiently open, when much of the antient Receiver is filled up.

So little has the Art of improving navigable Rivers, Harbours, &c. been attended to or understood by my Countrymen, that in the latter Part of *March*, or Beginning of *April*. in 1759, an *English* Engineer, (looked upon by Gentlemen as a very ingenious understanding Engineer) asserted before a Number of Gentlemen (the Place and Gentlemen's Names I could mention,) That if a Dam was made across the River *Wear*, to stop the Tide at the Low Key (which is only about a Quarter of a Mile from the Sea) it would in no Shape injure the Port.

To understand how far the above Assertion proves the Gentleman that made it an ingenious understanding Man, in the Affairs of improving navigable Rivers, Harbours, &c. the Reader must be acquainted that the fresh or land Stream, that comes down the River *Wear* in Summer, is little more than

than sufficient to make two Mills work. Great Land Floods generally happen only once in 3, 4, or 5 Years; and there are many Thousands of Tuns of Sand and Gravel cast into the Sea every Summer, within about three Quarters of a Mile off from *Sunderland-Bar*; a great Part of which the Sea throws a-Shore upon, and near to, the Entrance of the River *Wear*, and Port of *Sunderland*; so that the present Reflux (though the Spring Tides flow near Twelve Miles up the River) is barely sufficient to drive the Sand away, and maintain an indifferent Entrance; but if the Tide was stopped, (by a Dam as above) from coming up the River but for three Months, the Sand and Gravel would be thrown by the Sea, as high upon *Sunderland Bar*, as any other Parts of the Shore, save a very small Shallow Gut made by the upland fresh Stream, which would not receive a loaden Keel (much less a Ship) to sail into or out of *Sunderland Harbour*, except for about two Hours on the Top of Spring Tides. For,

It is evident the Flux and Reflux of the Sea, near the Land, make but a very weak Current directly toward the Land, or directly off to Sea, save where there is a considerable Receiver within the Land, like *Portsmouth Harbour*, *Southampton River*, &c. and the greater the Indraft, the greater Distance from the Shore doth it begin at. And if a Dam is made a-cross a River Six Miles up from the Sea, and stop the Indraft or Tide there, which usually flowed 10 or 12 Miles up the River; by this Dam the End of the Flux Stream would be only six miles from the Sea, instead of twelve; consequently six Miles length of Stream will not only be lost to the Navigation, but the Indraft or Inset and Outset will be much weakened, so that Vessels will lose the great Advantage of a strong Inset to carry them into the Harbour against strong off-Shore Winds, which

which is a material Point, and being wanting, renders the Entrance less navigable; and many Ships will be obliged to keep the Sea, which would have got the Harbour if the Dam had not stoppt the Tide, and weaken'd the Insett; to say more on this Head, would be superfluous, I having in the foregoing Pages prov'd that the lessening the Receivers of Rivers is greatly injurious, and may quite ruin the Navigation and Trade of a River, and totally stop the Tide with Dams from going up such Rivers, as the *Wear*; is ruining the Navigation to all Intents and Purposes at once; if Power had been obtained and a Lock made at *Biddock-Ford*, or Mr. *Lambtons high Staith*, or at either Place, the Navigation of the River *Wear*, and Port of *Sunderland*, would have been greatly injured, and the Public Loss would have been greater by stopping the Tide at *Biddock Ford*, than the greatest Advantage that could be hoped for, from the upper Navigation would make amends for; for great Tides fills the River two Miles and a half above *Biddoc Ford*, and two Miles above Mr. *Lambton's high Staith*, which part of the River holds a very useful Stock of back Water; without which, the Trade could not be carried so well on at the *Staiths*, nor could the latter part of the Tide run to Sea with a sufficient Force, to maintain so good a Channel to Sea, as is now, &c. all which put together (in my Opinion) would injure the Public more than ten thousand Pounds a Year; for the Value of a Foot depth of Water, lost or gained in the Entrance of the Port of *Sunderland*, is more than four thousand Pounds a Year lost or gained to the Public, as is clearly proved by an Estimate lately made, this being a Digression, I have not inserted the Estimate above-mentioned.

It may be proper in this Place, to obviate an Argument that has been made use of, to support an Opinion that large Receivers in navigable Rivers, Ports and Havens, are of no Consequence with regard to keeping the Entrances clear of Obstructions, &c. For say such superficial Reasoners, If the Outset is strong, the Inset is also strong, and brings Matter into the River to make Obstructions, in a Degree equal to the Strength of the Outset : Therefore the Strength of the Out and Inset of the Tide, is not of such Value as is imagined ; nor are large Receivers of any Consequence in maintaining a good Channel to Sea. Such Reasoners and such Reasons as to themselves doth not deserve an Answer, but as they sometimes do much Mischief, I will show the Fallability of this Manner of arguing.

Navigable Rivers generally have a considerable Stream of fresh Water, which runs from the Land, and impedes the Inset from the Sea, proportionally to the Quantity and Velocity of the fresh Water Stream in that River ; but when the Flux of the Sea recedes, and the Stream of the River returns back again towards the Sea, it meets no Hindrance from the Counter-Stream ; but the Outset increases in Force, as the Surface of the Sea lowers, and the Water that has been deposited by the Flux of the Sea far up the River, returns toward the Sea along with the natural Stream of the River, when the Sea has receded so far as to give no Obstruction to the Outset ; but that the whole Weight of the Stream scours the Bottom of the Channel or Bed of the River, and in many Rivers augments the Force of the Outset, to double the Force of the Inset ; not to mention the Advantage the Outset has, by the Descent the River's Bed has towards the Sea : And to prove that this is clearly agreeable to the Nature of Things, I must acquaint the Reader, that more
Water

Water goes out with the Reflux, than comes in with the Flux ; for all the time the Flux of the Sea repels the fresh Stream, the fresh Stream is filling the River jointly with the Flux of the Sea ; and what ever Quantity of Water came down the River in the time of the Flowing of the Sea, so much greater Quantity goes out with the Reflux, than comes in with the Flux. This is one Reason why the Stream of the Tide runs stronger out of than into Rivers. There is another Reason why a strong Inset doth not carry much Sand and Gravel into a River, and is this, The greatest Force where the Stream is not obstructed (but can run strait) is near the Middle of the River, and this Force gradually diminishes toward the Shore, where is little or no Stream ; so that what Sand, Gravel, &c. is raised by the Stream, it subsides towards the Shores, and in Eddies of Points, &c. till the Reflux remove it downwards toward the Sea ; and the Reflux being stronger than the Flux, it forces the Sand, Gravel, &c. further downwards than the Flux can carry it upward : This is the principal Reason why Rivers keep so well open where much Ballast is cast.

We are not without Instances of there being very good Harbours, that have little or no Land Water to assist the Reflux in keeping the Entrances open ; and yet the Entrances are sufficiently deep for the largest Ship of War to sail into or out of such Harbours, but then the Receiver within is very large : *Portsmouth* Harbour is an Instance and Proof of this ; it receives very little Land Water, and is a good Harbour for our largest Ships of War, notwithstanding the large Sands that lye before that Harbour's Mouth. I think this cannot be accounted for any better Way, than the Reflux is not impeded so much in its Course to Sea, as the Flux is in running into the Harbour ; therefore the Re-

flux runs out of the Harbour with a Force sufficient to keep the Entrance clear of Sands, Gravel, &c. *Portsmouth* Harbour plainly proves that a large Receiver will maintain a good Harbour, without the Assistance of Land Water: This appears to me another plain Proof of the Usefulness of large Receivers in Ports, Havens and navigable Rivers; and that the lessening Receivers in Ports, Havens and navigable Rivers, are injurious to Navigation.

Before I leave this useful Subject, I will endeavour to show the Reasons why much Expence has been bestowed to little Purpose, in deepening shallow Places in Rivers. I am the more induced to this by a Relation from a Person who was a principal Director in attempting to deepen a Shallow Part of a River in *Yorkshire*. He said a Body of Gentlemen of *York*, expended above £10,000 in this Attempt, and was at last obliged to make a Lock, to make that Part of the River navigable.

In attempting the deepening a shallow Part of a River, the first Thing proper to be known is, whether the Bed of the River above this shallow Place, is low enough to have a sufficient Depth of Water upon it for the Navigation, when the shallow Place is deepened; for where there is a Stream or sharpe in a River the Surface of the Water below that Stream is lower than the Surface of the Water above it; and when the Bed of the Stream is lower'd to the Level of the Bed of the River above it, the Water's Surface upward will become lower than it was before, consequently shallower. If the Water is sufficiently deep upward, a shallow Part below may be deepened to answer the Purpose, by employing as many Men as will in all Probability effectually remove the Obstruction before any Flood can bring fresh Matter there; I mean as many Men should be employed in a proper Season, as can do any Service; for no Man
can

can know how long it may be before a Flood happens; and that heavy Matter will generally rest where the River is shallowest, is plain and evident from common Observation, and from the Nature of the Actions of Fluids. For,

Fluids press and scower the Beds of Rivers with a Force proportional to the depth or perpendicular Height of the Stream, and not according to the Swiftmess and Breadth of the Superfices. If this is not the Case, how can we account for the deep Places of Rivers not filling up; for there the Water appears to have and has a very gentle Motion; but on the contrary, heavy Matter drops and lodges in the shallow Places where the Water runs swifter: This is self evident; and to give more Reasons than above why it is so, will be both mispending my time and the Reader's. Having first given the above Account, I think it proper to give the following Caution and Advice.

As I said before, remove the Obstruction with all Speed; for if you have proceeded and deepened a shallow Place a third, or a half of what it must be deepened, and if a Flood happen, it is very probable the Flood will leave near as much heavy Matter on the shallow Part, as you have taken away; and you may be served so many times until the Expence become unsupportable; but if you have the good Fortune to get the shallow Part all deepened equal to the River above and below, before a Flood come, every Part then will have an equal Force of Scowering; and in many Cases no Man can be assured where the next Obstruction will gather, or whether any will gather at all.

A P P E N D I X.

Of manning the British Navy with less Grievance to the Subject.

THIS great Object, I may venture to say, hath long taken up the Attention of several able and judicious Gentlemen, from whom different interesting Schemes and Plans have been produced ; one of which, in a late Sessions of Parliament, made a considerable Progress. But as Affairs of such high Importance carry with them their bad as well as good Effects, the above named Plan, after passing the Examination of the honourable House of Commons, two or three times, was found to bear too hard upon the Liberties of the Subject, and therefore was not carried into a Law. But the Gentleman who was Parent of it, had the private Thanks of several of the Members, who urgently pressed him to continue his good Offices towards the perfecting so desirable a Scheme, which the whole House seemed to have so much at Heart.

As this happened, since the first Advertisement of the **BRITISH MARS**, to the Plan of so able a Gentleman, it cannot be expected any Productions of my Pen would deserve Notice ; and I was once almost determined to forbear touching on that Subject : But when I reflected on the almost Impossibility of any one Person being able to form a Plan of that Kind, clear of Objections, and that it is yet probable from many proposed Schemes, a good one may be adopted. I have from a hearty Desire to be useful to the Public, at last ventured to offer the following

lowing to their Consideration ; and shall endeavour in the first Place to give an Answer to the general Complaint, That Seamen are worse treated than any other of his Majesty's Subjects.

Ist. As the present Manner of raising Seamen to man his Majesty's Fleet, is well known to most People in the Nation ; therefore Parents who bind their Children to the Sea Service, or others of adult Years who betake themselves to that Employ, should never complain whenever it falls to their Lot to be taken into his Majesty's Service, because they knew beforehand they were by the Custom of their Employ subject to it : And it is on that Account the Wages of Seamen in the Merchant's Service even in Time of Peace, are much higher than other labouring Peoples, and in time of War are carried to great Extravagancies ; therefore if the Expectation of such Gain draw them to Sea, they voluntarily bring upon themselves the Hardships complained of ; and the trading Part of the Nation, who pay such extravagant Wages, have a Right to their Service in the Navy, according to Custom prescriptively established.

IId. If there is any Injustice in the Case, it can only be in this, That Seamen are not taken in their Turns to serve in the Navy, and this fall chiefly among themselves, because of the great Difference between the Pay of the Navy and the Merchants-Service : Each one striving as much as possible to avoid the first, and obtain the latter. Now to bring the Wages in the two Services to near an Equality, will be bringing the Matter nearer to Justice ; and to which Purpose, the following Scheme, which if it could be brought about, would be a great Means to man the Navy with less Grievance to the Subjects. Tho' all possible Care has been taken by the different Acts of Parliament for the Encouragement

ment of Seamen to enter into his Majesty's Service, yet the great Difference of the Pay of Merchant Ships in time of War, from 3 or 4^l. per Month to that of the Navy, being only 22s. per Month, makes them very backward to enter, and even when on board to perform their Duty with great Reluctance. Now I would humbly propose that a Tax be laid upon every Seaman in the Merchant Service in time of War only, at so much per Month, as will be a Mean between the Pay in the Navy and the Merchantmen. This may be done by getting the Knowledge of the Wages paid by the Merchants in time of this and the two last Wars; and whatever the general Wages appear to have been more than the Pay in the Navy, the half of it should be the Tax laid on these in the Merchant Service, to raise a Fund for the Increase of these Seaman's Pay which serve in the Navy.

Suppose the Difference be 30s. only the half 15s. for the Tax to be paid by the Seamen in the Merchants Service, and carried to the general Fund; out of which should be paid 5, 6, 8 or 10s. per Month, as it would raise to every able Seaman in the Navy, and in Proportion to the rated ordinary, the Masters, Commanders, Apprentices, not liable to be impressed, excepted from paying any Tax, for the better Encouragement of raising Seamen by Indenture for three Years. For Example, Suppose fifteen Thousand Seamen liable to be impressed in constant Pay in the Merchant Service, and home Trade, their Tax at 15s. per Month, would raise 11250^l. per Month, the yearly Amount will be 135,000^l. which would give to 45,000 Men, employed in the Navy, 5s. a Calendar Month, over and above their common Wages. And if 8s. a Month, more or less, according to the Seaman's Will, out of their common Pay were added to that Sum, and supposing

135. a Month remitted constantly every half Year, after the first six Months, to their Wives and Families, it surely would have a very good Effect, and bring Men more chearfully to serve in his Majesty's Navy.

In Ships which sail Coast-ways by the Voyage, as they are seldom above a Month one Voyage with another, the Seamen may be taxed by the Voyage; and it would not be a difficult Matter to collect the Sum, if the Masters and Owners who pay the Seamen's Wages, are under severe Penalties for not paying into a proper Office, erected for that Purpose, the Sums becoming due for every such Seaman on board his Ship, for the Voyage or Month, every time the Voyage is finished and the Wages paid.

Something to this Purpose, joined with several good Proposals, mentioned in Capt. *Blake's* Scheme for manning the Navy, cannot fail of producing the following good Effects, viz. Seamen when impressed will not think it so great a Grievance to serve, because, in the first Place, their Pay will become nearer to Equality to those in the Merchant Service who pay so much back of their great Wages, to make their's the better; besides the Sum thus raised proceeding from the extravagant Wages in the Merchant's Service, will hardly effect other Individuals than the Tavern-keepers and Bawds of *Wapping*, and the principal Sea-Port Towns, who generally fleece the honest sailors of the greatest Part of their Wages, and leave them rotten Constitutions into the Bargain; add to these, the great Expence that may be saved by keeping a lesser Number of Tenders for the pressing Service, nor will so many Seamen be so cruelly confined in the Tender's Holds.

I don't pretend to say the above Scheme is free from Objections, no doubt, but several will be found

found in the establishing of it, but the greatest that occurs to me at present, will be, that Seamen knowing they have to pay such a Tax, will not go to Sea without having so much more Wages in Proportion to the Tax, and so it will fall upon the Trade. To this I answer, if that was the Case, it would become a greater Grievance than that intended to be removed; but I look upon our trading Gentlemen in whose Hands the whole of that will depend, to be better Managers; for if Seamen could have what Wages they please, they may as well insist on 10*l.* a Month, as three Pounds; and there would be no End to their Extortions. But as few of them cares to go to Sea whilst their Money lasts, it will be greatly the Merchant's Interests to keep the Wages low, for by that Means they may be able to trade with a smaller Capital to supply their Correspondents with cheaper Goods, and get their Ships the sooner and easier to Market.

I do not pretend to be capable of representing the Benefit of the above Scheme in all its Advantages. Its from a hearty Desire to do good to my Country I have published these few Hints (the first of which I had from a neighbouring Gentleman, viz. that of the Tax) expecting no more from them than that something may be gathered that may prove useful to an able Hand, towards the promoting any Scheme for manning the Royal Navy with less Grievance to the Subject.

C H A P. II.

WHEN we are blessed with a Peace, our Seamen will be too numerous to be all employed in the Trade *Britain* at present possesses : By thinking on this Matter, it appears to be the Duty of every *Briton* to publish any Plan he conceives carries a Probability of encreasing our Trade, and employing more Seamen. These Thoughts led me to re-consider the Nature and Trade of *Hudson's Bay*; and the twenty Thousand Pounds allotted by Parliament, as Part of the Reward for discovering the Northwest-Passage from *Hudson's Bay* to the Pacific Ocean, and great South Sea ; upon a thorough Recollection it appeared something more considerable might be done in that Part of the World, for which Purpose I formed the following Plan :

In the first Place, an Application must be made to Parliament, for an Act to enable his Majesty's Subjects to settle, and people Places in the Countries adjoining to *Hudson's Bay*, in order to carry on a Fishery all round the Bay, and in every River, Inlet, Creek, or Bay, without being obstructed by the *Hudson's Bay Company* ; giving proper Security not to interfere in the Fur-Trade.

Powers being obtained to people and cultivate any Part of the Countries adjoining *Hudson's Bay*, at a proper Distance from the Company's Factories, in order to carry on a Fishery. Places must be erected where Seamen may dwell, in a proper Part for Cultivation, near a navigable River, where Families when they could not fish, might find it worth their Trouble to cultivate the Land ; first for Greens and Roots, and after for Corn : There being already Plenty of Grass for Cattle, Horses, Sheep, Goats, &c. which cannot fail to increase, and yield Profit in

in the southern Parts of the Bay, in about 51, or near the Latitude of *London*; Swine and Beasts of all Sorts, has nearly as good a Chance there to be profitable as in *England* or *Scotland*.

The Rivers are clear of Ice sooner, by near a Month or six Weeks, in the southern than in the northern Parts of the Bay, consequently the fishing Season begins sooner there than to the Northward, by at least a Month or five Weeks. This Advantage, among many others of the Situation, not only gives the Fishers time when all together to prove any new Invention for killing more Whale; but also gives the Fishers an Opportunity to get to the northerly fishing Places in good time.

The principal Colony of Fishers being fixed in a Part of the Country that is capable of producing every Necessary of Life, the Fishery may be easily extended to every River on the southwest Coast, and the East Main where the *Eskimaux* doth not frequent for Fear of the other Indians.

It may be proper to observe, that by keeping a Net or two, let at the Mouth of every River, where Men are employed to kill Whales, as many Salmon and other good Fish may be taken, and salted, as will be a considerable Part of their Winter Subsistence.

The Vessel that is to collect the *Eskimaux* Trade, ought, the first Year, to proceed round the Bay, as soon as the Ice is gone off Shore, so as a small Vessel can sail between the Ice and the Shore. And at every Place where *Eskimaux* frequent, and can be spoke to, give them some Line, a light Harpoon, or two, a Cask, &c. and make them understand you as you can, by Signs, or otherways, that you will come next Year and trade for Whalebone, Oil, Sea-Horse-Teeth, Seal-Skins, &c. This do at every Place where you find any *Eskimaux*; but be sure and
by

by all Means, remember my Advice on this Point, which is, not to trust the *Eskimaux* (let their Appearance be ever so friendly) when they have Reason to think themselves too strong for you ; by many Accounts which I know to be true, joined to many other well attested Accounts, they are the most subtle, treacherous and cruel Savages in the known World ; therefore it should be long ere I would make any Settlements among them, but visit them yearly, and encourage them to kill Whales, &c. by giving them in Trade good suitable Fishing Tackle, and other most useful Things, to enable them to encrease their Trade. By this, and such like Treatment, they would in time become tractable Fishers, without any Danger from them ; for if they were assured of our coming yearly, they will procure all the Trade they can, and yearly look out for our Ships, and come off in their Canoes, as they do in the Straits to the Company's Ships. See what I say of the Fisheries, in my Account of *Hudson's Bay*, Page 63, of which the following is an Abstract :

“ The *Eskimaux*, who are the professed Fishers,
 “ used to inhabit the Country on the East Main, between the Straits and the Bottom of the Bay :
 “ But they are since driven away to the Northward, by the other Indians who are rendered much superior to them, on Account of the Supply of
 “ Arms and Ammunition, which they receive from the English : So that a Tract of Land of more
 “ than three Hundred Miles extent from North to South, lies almost waste, without Trade and
 “ without Inhabitants. *Churchil* River was much inhabited by the *Eskimaux*, before we settled
 “ there ; the Point on which the Fort is built, being called *Eskimaux* Point : Upon digging for the Fort
 “ many Traces were discovered of their abode here, such as the Pit in which they secured their Provisions

" fions, Pieces of Stone Pots, Spears, Arrows, &c.
 " This Point they kept some time after they were
 " driven from the adjacent Country, because as it
 " lies far into the open Sea, they could discover the
 " distant Approaches of their Enemies, and repair
 " in time to their Canoes, in the Management of
 " which they are peculiarly dexterous: But they
 " were at length forced to go farther northward to
 " Cape *Eskimaux* and *Whale-cove*; and are now to-
 " tally dispossessed of their Retreat, by our making
 " a Settlement here, and drawing down the North-
 " ern upland Indians to trade, whom also we have
 " supplied with Arms. But as People do not easily
 " lose their characteristic Virtues, that Art and In-
 " dustry for which the *Eskimaux* are distinguished,
 " they still retain, even in a State of Flight and
 " Dispersion; and those that are scattered about the
 " Straits, kill Whales, Sea Horses, Seals, Bears,
 " &c. not only for common Subsistence, but for
 " Trade, which they are very eager to carry on with
 " our Ships, as often as they go by in their Passage
 " to the Bay.

" A Sloop is sometimes sent to *Whale-cove* for a
 " few Days in a Season, and sometimes not sent at
 " all; the People, therefore, having no Dependance
 " upon our coming to trade with them, take very
 " little Care to provide a Supply larger than is neces-
 " sary for their own Subsistence.

" In those Years in which the Sloop was not sent
 " to *Whale-cove*, viz. 1745, 1746, and 1747, all
 " the Whale-Finns that the Company brought to
 " *England*, was procured in the Straits; the first
 " Year 303 Pounds; the second 1314 Pounds, and
 " the third 226 Pounds, in all 1843 Pounds, as
 " appears from the Account of their public Sales.
 " But in the seven preceeding Years, when the
 " Sloop was sent to *Whale-cove*, the Account of their
 Sales

Arrows, &c. they were because as it discover the and repair gement of : But they rthward to are now to- ur making he North- o we have o not easily rt and In- tinguished, Flight and about the als, Bears, e, but for ry on with er Passage -cove for a not sent at ependance take very n is neces- as not sent 1747, all rought to the first ounds, and ounds, as blic Sales. when the nt of their Sales

“ Sales stands thus : 1738, Finn 20 Pounds; 1739
 “ Finn 518 Pounds; 1740, Finn 630 Pounds,
 “ Oil 123 Gallons; 1741, Finn 149 Pounds; 1742
 “ Finn 679 Pounds, Oil one Tun at 18*l.* 13*s.*
 “ 1743, Finn 496 Pounds, Oil and Blubber 5
 “ Tons, 234 Gallons at 14*l.* 8*s.* per Ton; 1744,
 “ Finns 302 Pounds, Oil and Blubber 3 Tons, 218
 “ Gallons at 10*l.* 11*s.* per Ton : so that upon an
 “ Average, the Trade in Finns those Years in which
 “ the Sloop was sent to *Whale-cove*, does not equal
 “ the Trade when the Sloop was not sent; therefore
 “ the greater Part must have been procured in the
 “ Straits, which as I said before, is done cursorily
 “ as the Ships pass into the Bay. But if so much
 “ can be gained without any Efforts, what must the
 “ Produce be from a professed Design, and vigo-
 “ rous Endeavour to bring those Fisheries to Per-
 “ fection ?
 “ The previous Step to this, is the re-establishment
 “ of the *Esquimaux* in the quiet Possession of their
 “ Properties and Lives ; suffering them to extend at
 “ Pleasure towards the Bottom of the Bay, where
 “ they would find a milder Climate and better Coun-
 “ try ; which abounds with Wood and good Har-
 “ bours ; and taking Care to inform the Indians
 “ upon the Eastern Main, that the *Esquimaux* are
 “ desirous to live at Peace with them; that they
 “ will not interfere in the Fur-Trade, and that
 “ they are Friends to the *English* and under their
 “ Protection, who, if Hostilities are continued,
 “ will supply them with Arms and Ammunition for
 “ their Defence : Which impartial Distribution of
 “ Kindness and good Offices would effectually dissi-
 “ pate that Malignity we have given way to by the
 “ opposite Conduct, to the Destruction of both Peo-
 “ ple, and the Ruin of the Trade. And if the
 “ same pacific Measures were taken also on the
 “ Western

“ Western Coast, Southward of *Whale-cove*, for
 “ the Protection and Encouragement of those *Eski-*
 “ *maux* who lie scattered thereabout, the Foundati-
 “ on of a most extensive Fishery would be effectually
 “ laid.

“ These last *Eski-maux* subsist in Winter upon the
 “ Stock they raise in Summer, which is supposed to
 “ be Oil, Blubber, and the like ; and yet the Sea-
 “ son of the Whale-Fishery there seldom lasts above
 “ nine Weeks ; in which time they must kill a pro-
 “ digious Quantity to be able not only to lay up a
 “ Store for a long Winter, but to make a Reserve of
 “ Tuns of Oil for the Company's annual Sloop :
 “ And if this poor People can in their one Man
 “ Canoes, with such Tackling as their little Skill
 “ enables them to make of Ivory, Wood and Lea-
 “ ther, kill so many Whales in so short a Time, and
 “ in so small a Part of the Bay, there is no fixing
 “ Bounds to the Proportion, if a Fishery was carri-
 “ ed on at the Rivers, under proper Directions and
 “ Encouragement, and the Natives furnished with
 “ Harpoons, Nets, Hooks, and other Tackling
 “ made in England ; and prompted besides to exact
 “ their utmost Art and Industry, by a kind and ge-
 “ nerous Treatment.

“ The Circumference of the Bay is at least 2500
 “ Miles, with so many Rivers and Inlets all round,
 “ that a considerable River or Inlett may be allowed
 “ to every hundred Miles. In the Rivers where
 “ I resided, as much Oil, &c. might be procured,
 “ as would be sufficient to load 150 Tons of Ship-
 “ ping annually ; consequently by the same Com-
 “ putation, the whole Bay would employ 1250
 “ Tons ; and in a short time I dare say, many Hun-
 “ dreds more ; but the first Attempt must be made
 “ by those who are possessed of Judgement, Spirit,
 “ and

“ and Integrity, or no plan however excellent,
 “ would insure Success.

“ It should be objected, that since the westerly
 “ Rivers in the Bay are not clear of Ice till the Begin-
 “ ning of *June*, and the Fishery is over by the mid-
 “ dle of *August*, the Season would last only ten
 “ Weeks, which would be too short to kill Whales
 “ enough to defray the Expence : I answer first,
 “ that the Fisheries of *Greenland* and *Davis's*
 “ Streights do not last longer ; and secondly, that
 “ the Expence in a great Measure might be saved,
 “ if as the Bay Fishery does not begin till the
 “ *Davis's* Fishery is over, the same Ships were em-
 “ ployed in both. It is to be further objected,
 “ that Ships cannot get into the Bay by the Begin-
 “ ning of *June*, and therefore a great Expence
 “ would be incurred by so many *English* being
 “ obliged to winter there. I answer farther, that
 “ few *Englishmen* need be kept in the Bay, since the
 “ Natives may be hired upon very reasonable terms,
 “ to attend the whole Time of the Fishery. The
 “ home *Indians* even now kill Geese for the Com-
 “ pany for very low Wages, and a much greater
 “ Number offer themselves for this Service than
 “ can be employed, and the Season of killing Geese
 “ is generally over a Week before the Fishery Sea-
 “ son comes on : Indeed these home *Indians* are ten-
 “ der, dull and inactive, but they need only be em-
 “ ployed in the Fishery whilst in its infant State ; for
 “ upon making Peace between them and the *Eski-*
 “ *maux*, those native Fishers would carry on the
 “ Business alone, without any assistance from the
 “ home *Indians*, or even from the *English*, who
 “ need only act as Supervisors ; but should it be at
 “ last objected, that the Company long before this
 “ would have set such a Fishery on foot, if it was

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“ neve

“ near so beneficial as is now represented; the Answer may be easily drawn from their while Conduct for many Years past.” As I was six Years in *Hudson’s Bay*, I am acquainted with their Policy and Manner of Acting there, and the Reasons why the Company have not made any considerable Progress in the Fisheries and other Improvements.

Before I dismiss this Head, it may be proper to give it as my Opinion, that Methods may be taken, whereby six or seven Men cannot fail (if they use their utmost Endeavours) to kill as many Whales in a Week, as will yield seven Tons of Oil, and perhaps a great deal more; and if an Act could be obtained to settle a Colony in the southern Parts of the Bay, in order to carry on the Fishery or other Trade, and make Discoveries that the Company doth not look after; and if a proper Number of Merchants or Gentlemen, form themselves into a Company for that Purpose, I will not only be glad to forward the Affair with all the Information I can give; but to prove I have the greatest Hopes of Success, I will subscribe above one Hundred Pound out of my small Fortune.

Of a Copper Mine near Hudson’s Bay.

In the Course of carrying on the Fishery and other Affairs, perhaps better Information may be got, for this Copper Mine for the Space of forty or fifty Years last past, has been much talked of in the Bay; and those who understand the Country Language best, have long ago been thoroughly convinced of the Existence of this Mine, and also of the Practicability of getting at it. I have seen of the Copper (that the *Indians* said that they brought from the Mine) about the *Indians* Wrists for Ornament, and also some Pieces, some of which I brought to *England*;

land; and in the Year 1718, when the Company first settled a Factory at *Churchill* River, and before the northern *Indians* had any Iron Utensils from the *English*, some *Indians* that came from the Northward (called Copper *Indians*) had Ice Chisels and other Things of Copper, which the *Indians* said they got at the Side of the Sea, a Creek or Streight; and these Accounts have not been contradicted, at least not as I have heard of. See my Account of *Hudson's Bay*, Page 69.

As I do not believe every Thing I hear as true, so I do not wholly rely upon every Information I have had by the Linguists; for in the first Place, the *Indians* Accounts are not always to be depended on as true, for when they find you are so pleased with their Story, as to give them something, and desire they will inform themselves better, and give you an Account the next Time they come; whether they get any better Information or not, they'll prepare a Tale they think will please you: And in the second Place, the Linguists in the Bay are not so understanding in the *Indian* Languages, especially the northern *Indians* Language, as to be able to cross examine them, and consequently may not rightly understand the Meaning of every Word the *Indian* speaks; and also the Linguist thinking thereby to please his Superior, may be suspected of saying at one Time or other more in favour of a Discovery, than he has sufficient Grounds or Authority from the *Indians* for.

After giving proper Allowances for the false Accounts, and the Difficulty of coming at the Truth as abovementioned, I am, from many corroborating Accounts, as well assured there is a Copper Mine at the Place the *Indians* speak of, as I am assured of the being a Place called *Siberia* in *Russia*, or the being

of any other Place I have not seen. That *Englishmen* may go to this Mine is evident by the *Indians* being able to go to it, who have their subsistence to procure Day by Day upon the Spot, which need not be the Case of the *Englishmen*; and if it is not a tolerable Place, and something to be got there to subsist on, I think the *Indians* would not go there: But if they go to this Mine only for the Sake of getting Copper to make Ornaments for their Wrists, &c. when they can have the same Sort of Ornaments (and more beautiful) for a Trifle at the *English* Factory, where they also visit every Year; and as the *Indians* are more sparing of Labour than *Englishmen* are, it is not unreasonable to conclude, that the *Indians* would not go to the Copper Mine if it is far out of their Hunting Grounds, and in a desolate Country; nor will they take much Trouble to procure what they can procure readily with little Trouble, from all which I think it is not unnatural to infer that the Copper Mine is in or near the *Indians* Hunting Ground: And as it is found by Experience, that *Englishmen* can travel in those Countries as well as the *Indians*, there cannot be in the discovering this Mine any Difficulty equal to the Importance of the Discovery.

Of the North-West Passage.

In order to discover the Existence and Situation of the North-West Passage (supposed to be from *Hudson's Bay* to the *Pacific Ocean* and *South Sea*) I would build five Boats with Bend-leather in the Place of Plank, light and well constructed for Defence against the *Esquimaux*, and seven Men in each Boat, each Man armed with a short Gun, Pistols and Sword, each Boat to have two Swivel Blunderbusses; two of these Boats ought to sail from the Bottom of
the

the Bay, and three from *Churchill* as soon as there is any Probability of a Passage along Shore, between the Shore and the Ice; one of the Boats from the Bottom of the Bay, to lye at Anchor in the Mouth of *Hudson's* Streights, the other in about sixty-five on the east Coast; one of the Boats from *Churchill* to anchor near the west Shore in about 62, another to anchor near *Cape Fry* in 64. 40. and the third to proceed to 67 or 68, if not obstructed by the Ice, or as far to the Northward as possible, without too great a Risque. The Boats that do not proceed so far to cruise about, and make what Discoveries they can till they suppose the northermost Boat has got to her Station; every Boat must observe the Winds, and be very exact as to the Time of Flood, the Direction and Strength of the Stream, both Flood and Ebb, the Time of High Water, and the Heighth it flows in Feet and Inches, &c. and at what Time of the Flood and Ebb the Stream runs strongest, &c.

Caution and Direction.

The Boats to lye as clear from Islands as possible, that they may not lye in a counter Stream; one Half the Crew watch at a Time in the Night, and two in the Day, and keep a good Look out; suffer no *Eskimaux* upon any Pretence to board your Boat; look with your Gla's very often all round, especially upon the Land, to see if you can discover any living Creature: This may prevent your being surpris'd by the *Eskimaux*; keep your Fire-arms clean, loaded and ready, try to catch Fish, &c.

Set up a Pole marked with Feet and Inches at the lowest Low-water Mark, to shew when it is Low-water, when Flood, when High-water, and the Time the Water keeps up at its Heighth, and whether

ereth is a sudden Rise of the Water when young Flood, or when near High-water, or if there are two High-waters; that is, whether the Water rise a second Time in three Quarters of an Hour, or one Hour and an Half after the Tide has been at its Highth and Ebb for a considerable Time. About Half an Hour or an Hour before Low-water, put your Boat near the Shore that you may plainly see the Water rise or fall upon the Shore and Pole; when you plainly perceive the Water rise, allow six or eight Minutes out of the Time the Water neither fell or rose, for its Beginning to rise before you could be sure that the Flood made it rise; then put off to your Station, and observe the Stream till about one Hour before High-water, when put your Boat near the Pole again, to observe the Rising of the Flood and Time of High-water, &c.

A Leather Boat of about four Feet and a Half long may be made, to have a Bag of Leather at her Bottom, to take up through the Bottom into the Boat or let down thro' the Bottom, and filled with small Stones or Sand so as the the Weight of a Man cannot overset her: This Boat will serve to go near the Shore, and observe by the Pole the Rise and Fall of the Water; if you are disturbed by the *Eskimaux*, remove twenty or thirty Miles either Way you chuse along Shore, only know the Latitude you make your Remarks in.

The Scheme is the more practicable, as there is little or no Night in the Latitudes the Boats are to lye in all the Time the Boats need be upon this Service, and the Ice in the Bay prevents there being any Sea, let the Wind blow ever so strong.

The above Remarks being made by the Boats at their several Stations upon one and the same Day, and upon one and the same Tide, there can be no doubt of being directed to the right Place where
you

you cannot miss of further Information, and if the Passage is practicable, you cannot fail of finding it.

I think my giving any Directions how to make use of the above Remarks cannot be necessary, as every expert Seaman is better able to form a proper Judgment of such Affair.

As I have wrote much concerning the Trade of and Discoveries in *Hudson's Bay*, and in 1752 published a Book in which are many Facts that reflect no Honour on the *Hudson's Bay Company*; since I may think I write out of Rancour, Envy, or Revenge; therefore, to obviate Censure, I think it proper to declare, that if I were convinced of the *Hudson's Bay Company* using their utmost Endeavours to obtain all the Trade that is to be had in the Bay, Streights, &c. I would explain the Methods by which I think much more Trade may be obtained to the *Hudson's Bay Company*, with as much Pleasure as I would to any other Set of Gentlemen, for I want no Profit out of *Hudson's Bay*, and it will be equal to me who increase the Trade and employ our Seamen, so it is but done to the utmost Extent.

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An Abstract of an Account of the Captivity of the Wife and Children of
JOHN HANSON.

ON the 27th of the sixth Month called *August*, 1725, my Husband and all our Men Servants being abroad, eleven *Indians* armed with Tomahawks and Guns, who had some Time before been skulking about the Field, and watching an Opportunity of our Mens Absence, came furiously into the House. No sooner were they entered, than they murdered one of my Childern on the Spot, intending no doubt by this Act of Cruelty, to strike the greater Degree of Terror into the Minds of us who survived; after they had thus done, their Captain came towards me with all the Appearance of Rage and Fury it is possible to imagine, nevertheless upon my earnest Request for Quarter, I prevailed with him to grant it.

I had with me a Servant Maid and six Children, but two of my little ones were at that Time playing in the Orchard; my youngest Child was but fourteen Days old, and myself of Consequence in a poor weak Condition, and very unfit to endure the Hardships I afterwards meet with, as by the Sequel will appear.

The next Step they took was to rifle the House, which they did with much Hurry and Precipitation, being apprehensive in all Probability of a Surprise; and as it was late in the Afternoon, they packed up what Linen, Woollen, and other Things they liked, and forthwith turned us out of the House.

Being

Being now at the Door, my two Children who have been playing in the Orchard (the one six and the other four Years of Age) came in Sight, and being terrified at the Appearance of the naked *Indians*, they cried aloud, on which one of the *Indians* ran up to them, and taking one under each Arm brought them to us; my Maid prevailed with the biggest to be still, but the other would not be pacified by any Means, but shrieking and crying very much; whereupon to ease themselves of the Noise, and prevent the Danger of a Discovery that might arise from it, they made no more to do but knocked out its Brains before my Face.

The *Indians* having now killed two of my Children, the next Thing they did was to Scalp them, a Practice common with them whenever they kill any *English* People; this they do by cutting off the Skin from the Crown of the Head, which they take with them as an Evidence of the Number they have slain; and it has been currently reported, that the *French* in their Wars with the *English*, have given the *Indians* a pecuniary Reward for every Scalp they brought to them.

This being done, they prepared to leave the House in great haste, without committing any other Violence than taking what they had packed up, together with myself and little Babe fourteen Days old, my little Boy of six Years, one Daughter about Sixteen, another about Forteen, and my Maid Servant.

It was, as I said before, but fourteen Days since my Lying-in, and being very tender and weakly, and turned out from my warm Room with every Thing suitable to my Circumstances, it increased the Severity of the Hardships I underwent exceedingly; nevertheless I found the Case was such, that I must either go or die, for I could make no Resistance neither would any Persuasions avail.

Accordingly

Dept.

Accordingly we began our Journey, each having some of the Plunder to carry, and I my Infant: the other three were now able to travel alone. But my new Master, the *Indian* Captain, was sometimes humane enough to carry my Babe in his Arms; which I looked upon as a singular Favour, because he had besides a vrey heavy Burden, and considerably more than he could take up without the Help of his Men.

We passed through several Swamps and Brooks, carefully avoiding all beaten Paths, and every Track that looked like a Road, lest we should be surprized by our Footsteps.

We travelled that Night, I suppose, near ten Miles, in a direct Line, and then we halted. The *Indians* kindled a Fire, and we took up our Quarters by it. They took it in Turn to rest themselves, while a Party of them kept Watch, in Order to prevent a surprize.

Thus did we travel for twenty-six Days successively, and, in general, very hard; though sometimes we were helped a little, by Water, over Lakes and Ponds.

Next to the Difficulty of crossing the Rivers, were the prodigious swamps and Thickets, which were very hard to pass through. But here also my Master would sometimes lend me his Hand; and, as they passed through quickly, one after another, it became pretty tolerable for the hindmost. But the greatest Difficulty of all, and which deserves first to be named, was our Want of proper Sustenance: for we were now reduced to very great Extremity; having often nothing to eat but Pieces of old Beaver-skin Watch-coats, which the *Indians*, in their Journey to our Settlement, had concealed, (for they came to us naked, as I said before) but now, in their Return, took along with them. They were used more for Food than Raiment; being cut out in long, narrow

row Straps, of which they gave us some little Pieces. These, after their Example, we laid upon the Fire till the Fur was singed off, and then ate them as dainty Morsels; experimentally knowing, that, to the Hungrey every bitter Thing is sweet.

Of this Diet, mean as it was, we had but a scanty Allowance. And, what still further increased my Affliction: was, the Complaints and Moans of my poor Children. Sometimes indeed the *Indians* caught a Squirrel, or a Beaver; at others, we met with Nuts, Berries, and Roots; and sometimes we ate the Bark of Trees; but had no Corn for a long while, till a Party of the younger *Indians* went back, and brought some from the *English* Inhabitants, of which they gave us a very short Allowance. But, when they killed a Beaver, we lived high while it lasted; as their Custom was to allow me the Guts and Garbage for myself and Children; but they would by no means suffer us to wash and cleanse them; which occasioned this Kind of Diet to be very loathsome: and indeed nothing but pining Hunger would have made it in the least Degree tolerable.

When we were pretty far advanced in our Journey, the *Indians* divided; and, to our great Sorrow, divided us amongst them. My eldest Daughter was taken away first; and carried to another Part, far distant from us; and we had not travelled far, before they parted again, and took from me my second Daughter, and my Servant Maid; so that I had only the Babe at my Breast, and my little Boy of six Years old; we three remained with the Captain: but my Daughter and Servant underwent very great Sufferings after they were taken from us; travelling very hard for three Days together, without any Sustenance but cold Water, and, on the third Day, the Servant fell down in a Swoon, as dead; at which the *Indians* seemed surprized, and began to show some Signs;

Signs of Tenderneſs, not being willing to loſe any of their Captives by Death, after they had brought them ſo near their own Home; hoping no Doubt, in Caſe they lived, to obtain a conſiderable Price for their Ranſom. Accordingly, in a few Days after this, they drew near their Journey's End, where they found greater Plenty of Corn, and other Food; but Fleſh often fell very ſhort, as they had no other Way of procuring it but Hunting.

It was not long before my Daughter and Servant were parted alſo; and my Daughter's Maſter falling ſick, he was thereon diſabled from hunting. All their Corn was likewiſe ſpent; and ſo great were their Diſtreſſes, that they were compelled to feed upon the Bark of Trees for a whole Week, being almoſt famiſhed to Death.

At Length we arrived at the *Indian* Fort, where many of the People came to viſit my Maſter, and his Family, and congratulate him on his ſafe Return, and the Succeſs of his Expedition. Public Rejoicings were made upon it (which, in their Way, perhaps were a Kind of Thankſgiving); and theſe were attended with Dancing, Firing of Guns, Beating on hollow Trees, inſtead of Drums, Shouting, Drinking, and Feaſting for ſeveral Days, together with much Exceſs.

We had not long been arrived before my Maſter went abroad to hunt for Proviſions for the Family, and was abſent about a Week. Before he ſet out, he ordered me to procure Wood, and gather Nuts: In doing which I was very diligent, during the Time of his Abſence, in cutting the Wood, and putting it up in Order. But no ſooner was he returned, than I quickly perceived he was very much diſpleaſed; for he had met with no Succeſs in his hunting Expedition; and ſo ſtrongly did his Diſappointment work upon him, that he began to revenge it on us his Captives.

Captives. He allowed me however a little boiled Corn for myself and Child; but looking upon us with a very angry Countenance. he threw a Stick at me, with such Violence as plainly demonstrated, that he grudged us the Food we had received from him.

The poor old Squaw, his Mother in-law, was very kind and tender to me, and, all that Night, would not leave me; but came and laid down at my Feet, signifying her Intention to use her Endeavours to appease his Wrath. For my own Part, I got but little Rest that Night; though my Babe slept sweetly by my Side: but I dreaded the tragical Design of my Master, and looked every Hour when he would enter the Wigwam, to execute his bloody Purpose. But here again kind Providence interposed. For, being weary with hunting, and having toiled in the Woods without Success, he went to Rest, and forgot to put in Practice the horrid Purpose he had formed.

When Flesh was scarce, we were only allowed the Guts and Garbage; but were not permitted to cleanse them any other Way than just by emptying the Dung out of them, and afterwards boiling them together with the Broth of Fowls; which would have been extremely nauseous, had not Hunger compelled us to eat; but in Time this Kind of Food, which often fell to our Lot, became pretty tolerable to a keen Appetite; though, at another Time, I could by no Means have dispensed with it. And this led me to consider, that none are able to say what Hardships they can suffer till the Trial comes upon them. For that, which in Time past I had thought not fit for Food in my own Family, I should now have esteemed a sweet Morfel, and a dainty Dish.

By this Time I was reduced so low, through Fatigue of Spirits, hard Labour, mean Diet, and the frequent

frequent Want of natural Rest; that my Milk was intirely dried up again, and my helpless Babe very poor and weak, appearing to be little more than Skin and Bones; for I could perceive every Joint of it, from one End of its Back to the other; and how to procure any Thing that might suit its weak Appetite, I was at a very great Loss. Whereupon one of the *Indian* Squaws, perceiving my Uneasiness, began Discourse with me, and withal advised me to take the Kernels of Walnuts, and after I had cleansed them, to beat them up with a little Water, which accordingly I did, and the Water looked like Milk; then she bade me add to this Water a little of the finest *Indian* Corn-meal, and just boil it up together: I did so, and found it very palatable; and soon perceived that it nourished my Babe, for it quickly began to thrive, and look well; which gave me great Comfort. I afterwards understood, that with this Kind of Diet the *Indian* Children were often fed.

But the Comfort I received, on my dear Child's Recovery from the Brink of Death, was soon mixed with Bitterness and Trouble; for my Master, observing its thriving Condition, used often to look upon it, and say, that, when it was fat enough, he would have it killed and eaten. Pursuant to this Threat, he obliged me to fetch a Stick, which he said he had prepared to roast my Babe upon. And, as soon as I had brought it, he made me sit down by him, and undress the Infant. The Child now being naked, he began to feel its Arms, Legs, and Thighs; and having passed this Examination upon it, he informed me, as it was not yet fat enough, I must dress it again till it was in better Case. But, notwithstanding he thus acted, I could not persuade myself he was in earnest, but that he did it with a View to afflict and aggravate me: neither could I think but that our Lives would be preserved from
his

his barbarous Hands, by the over-ruling Power of him, in whose Providence I put my Trust both Night and Day.

A few Weeks after this, my Master made another Remove; which was the longest he ever made, being two Days Journey, and mostly over the Ice. The first Day the Ice was bare; but some Snow falling on the Second, it made it very difficult to travel over. I received much Hurt by frequent Falls: having besides the Care of my Infant, which increased my Trouble not a little. It was Night when we arrived at our Camp, and I was ordered to go and fetch Water; but having sat a while on the cold Ground, I could neither stand nor go, by Reason that my Limbs were so benumbed with cold. Yet I dared not refuse; and therefore attempted it by crawling on my Hands and Knees; but a young *Indian* Squaw, belonging to another Family, being come to see our People, she, in Compassion, took the Kettle, and knowing where to go, which I did not, fetched the Water for me; which I took as a great Favour, in that her Heart was inclined to do me this Service.

I now saw the Design of this Journey. My Master, being weary of keeping us, was willing to make what Ransom he could of us; and therefore went farther towards the *French* Settlements, leaving his Family at this Place; where they had a great Dance, several other *Indians* coming to our People. This held some Time; and, while they were employed in it, I got out of their Way, as far as I could, into a Corner of the Wigwam: But every Time they came by me in their Dancing, they would Bow my Head towards the Ground, and frequently kick me with great Fury. Divers of them were barefooted, and the rest had only Mocks on. The Dance lasted
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some Time ; and they made, in their Manner, great Rejoicing and Noise.

It was not many Days before my Master returned from the French ; but, in such an ill Humour, that he would not suffer me to abide in his Presence. I had a little Shelter, made with Boughs ; having first digged through the Snow, quite to the Ground. In this Hole I and my poor Children were put to lodge ; and, as the Weather was then very sharp, and the Frosts very hard (it being then the Month called *January*) our Lodging was extremely bad. But our Stay was not long in this wretched Place, before my Master took me and my Children to the *French*, in Order to get a Chapman for us : when we came among them, I was exposed to Sale, and the Price my Master put upon me was 800 Livres. But, nobody appearing disposed to comply with his Demands, and a Frenchman offering no more than 600 Livres, it threw him into such a Rage that he said in his Passion, if he could not have his Price he would burn me and the Babe in the View of the City of *Port Royal*. The Frenchman bade him make the Fire ; and added, I will help you, if you think that will do you more good than 600 Livres ; “ calling him Fool, and roughly bidding him be gone : ” but, at the same Time, he was very civil to me ; and, for my Encouragement, bade me be of good cheer, for I should be redeemed, and not go back with the *Indian* again. I was obliged however to retire with my Master that Night ; but, the next Morning I was redeemed for 600 Livres.

In driving the Bargain with my Master, the Frenchman asked him why he demanded so much for the little Babe's Ransom ; urging, that when it came to have its Belly full it would die. The *Indian* said, No, it would not die ; having already lived twenty-six Days on nothing but Water ; and that

that he believed it was a Devil. The Frenchman said no, but the Child is ordered for longer Life; and it hath pleased God to preserve it to Admiration. My Master answered, No, that was not the Case; but that it was a Devil, and he believed it would not die, unless they took a Hatchet and knocked out its Brains.

I had then been about five Months among the *Indians*, and one Month with the *French*, when my dear Husband, to my unspeakable Joy and Comfort, came to me. He was much concern'd for the Redemption of his Children; two of our Daughters, and the Servant-maid, being still in the Hands of the *Indians*; and only myself and the two little ones redeemed.

Accordingly, after much Difficulty and Trouble, he recovered our younger Daughter, and the Maid; but we could by no Means obtain our eldest from them. For the Squaw to whom she was given, had a Son; and she intended a Match between my Daughter and him, hoping in Time to prevail upon her to comply: for the *Indians* are seldom guilty of any indecent Carriage towards their captive Women, unless much overtaken in Liquor. The Affection they had for my Daughter made them refuse all Offers and Terms of Ransom; so that, after my Husband had waited, and used his utmost Endeavours to obtain our Child, we were obliged to depart homewards, and leave our Daughter, to our great Grief, amongst the *Indians*.

We accordingly set forward over the Lake, with three of our Children and Servant, in Company with several others; and, by the Kindness of Providence, got well home, on the first of the seventh Month, called *September*, in the Year 1725, from which it appears, that I had been from home, amongst the *Indians*

Indians, and French, and upon my Journey, twelve Months and twenty-six Days.

But my dear Husband could not enjoy himself with Satisfaction, our eldest Daughter being yet in the Hands of the *Indians*; he therefore began a Second Journey, about the 19th of the second Month 1727, in Order to redeem her, in Company with a Kinsman and his Wife, who went to redeem some of their Children, and were successful to their Desire; but my dear Husband died in the Woods, about half Way between *Albany* and *Canada*, in my Kinsman's Arms.

N. B. The Substance of the foregoing Account was taken from her own Mouth by *Samuel Bowmas*. And, in the seventh Month, called *September*, 1741, *Samuel Hopwood* was with her, and received the Relation much to the same Purpose; at which Time he saw the Child (then grown a young Woman) who was sucking at her Breast when she was carried into Captivity.

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